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No. 13 TRANSVAAL 1962

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ADMINISTRATION OF THE PROVINCE OF TRANSVAAL

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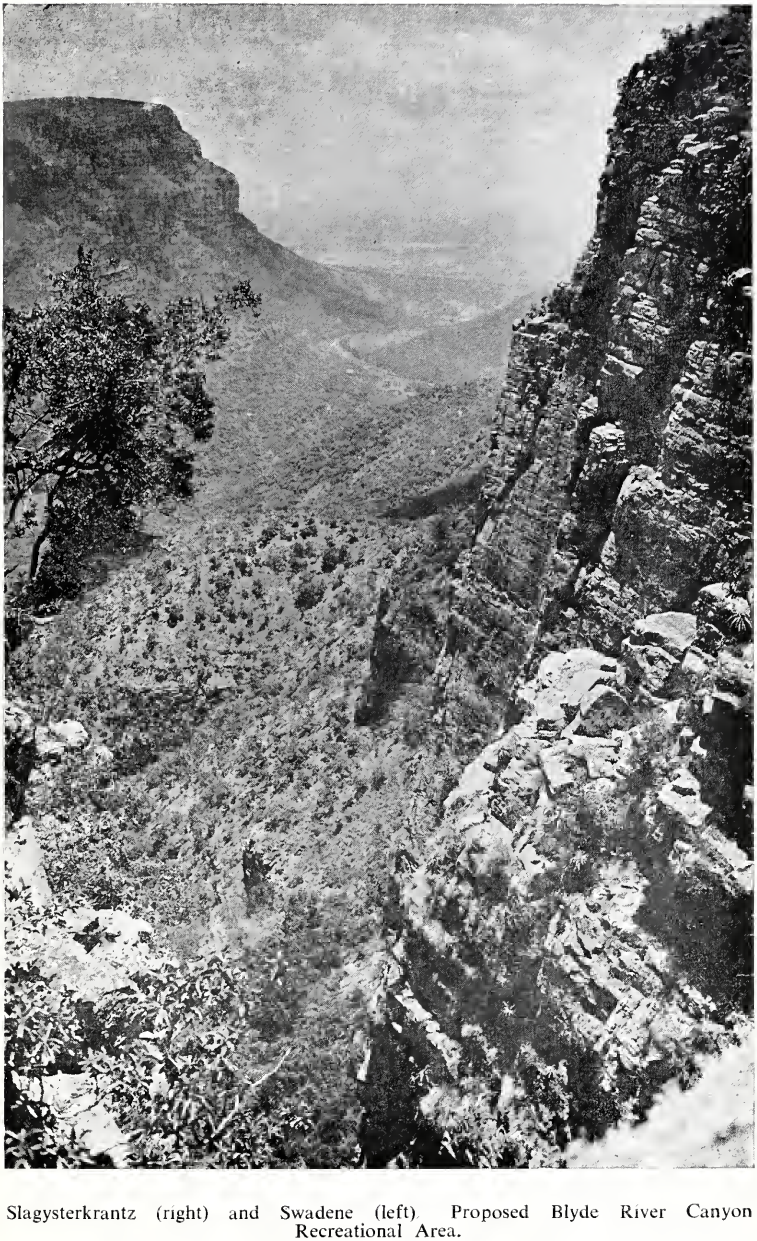
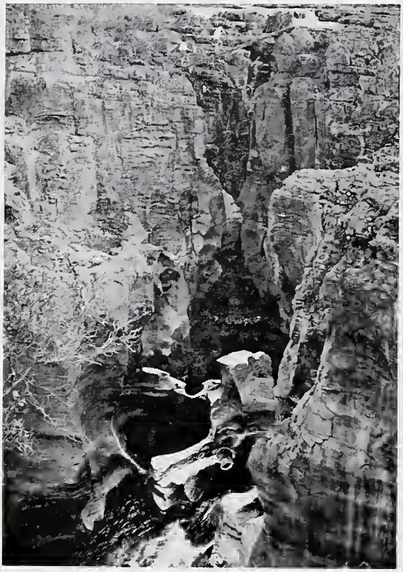


Slagysterkrantz (right) and Swadene (left). Proposed Blyde River Canyon Recreational Area.

(Photo: Corrie Roux.)

NATURE CONSERVATION AND OUTDOOR RECREATION

T. J. Steyn



Bourke's Luck Potholes. Proposed Blyde River Canyon Recreational Area.

(Photo: Corrie Roux.)

OUTDOOR recreation is a statutory function of the province and is accepted as such also by the Public Service Commission. Firstly, the recreational aspect is considered an integral part and object of the conservation of game, fish and flora. Otherwise the conservation activities of the province would be largely meaningless and without aim. The inland fisheries, for example, are concentrated entirely on the angling sport. There is not a single commercial fishery in the public waters of the Transvaal, but there are more freshwater anglers than in the rest of the Republic combined.

In the second place, the Public Resorts Ordinance (No. 10 of 1953) provides for "the control, management and development of places of public resort or public recreation". This ordinance applies to state land reserved at any time by the State President in terms of the Financial Relations Act as being a place of public resort, of public recreation, or of historical or scientific interest, and which is included in the schedule to the ordinance.

The first area developed in terms of this ordinance was the well-known and popular nature reserve and public resort at Loskop Dam. A fairly comprehensive description thereof appears in *Fauna & Flora* No. 11 of 1960. The following figures show how the numbers of visitors to the resort are increasing:—

Year	*Visitors*
1959	27,000
1960	36,300
1961	46,250
1962	57,860

During 1963 the existing accommodation will be more than doubled, partly as the result of the provision of special housing and other facilities for visiting school and youth groups. The school tour service of the Transvaal as well as the Department of Education, Arts and Science, is very interested in the latter development in particular. A visit to Loskop Dam should fit in nicely with the existing educational tours in which the F. C. Braun Aquarium, Lydenburg (with an annual number of visitors exceeding 25,000) has already been included.

The Ohrigstad Dam area was the second to be reserved by the State President, and its development is in the planning stage at present. In the meantime the Administration has started negotiations regarding the acquisition of state land at the following five places as well: Pienaar's River Dam, Sterkrivier Dam, Ebenezer Dam, Pongolapoort Dam and the proposed Blyde River Canyon recreational area.

It should not be deduced from the above that the concept of outdoor recreation is interpreted merely as the provision of a few resorts at selected dams and rivers, since the province does realize that it should be implemented in accordance with accepted standards and requirements in respect to, *inter alia,* town planning, peri-urban facilities, regional needs, provincial wilderness areas, etc. The province accepts also that efficient management demands the appointment of professionally trained personnel in a specific sub-section for public recreation.

Perhaps it is not generally known how much the province already does, directly or indirectly, in the field of outdoor recreation. Angling undoubtedly makes the biggest single contribution in this respect, bigger even than that of the organized games. According to a recent survey, 62,000 licenced anglers spent a total of ± 1,860,000 angler days per annum at the waters of the province, and expended ± R4,960,000 on their sport. They caught over 4,000,000 fish with a total weight of ± 4,030 tons. This included neither the recreation of a further 20,000 minors and thousands of riparian owners (who did not require angling licences) nor that of relatives who accompanied the anglers. It is the policy of the Administration, therefore, to maintain and improve this angling.

As for hunting, over 4,000 permits and licences are issued annually for a total of ±40,000 antelopes, 60,000 game birds and 2,000 hares. To this one may probably add an equal number of animals shot as "open game" by landowners without permit or licence. We do not know how much recreation is provided by illegal hunting; but we do know that 27 Bantu Game Rangers under the guidance of 7 Nature Conservation Officers in 7 lowveld districts effected a total of 2,565 convictions during the two financial years 1959-61. Penalties totalled R95,526 in fines and/or 5,779 months of imprisonment and 124 strokes with a cane.

It is the policy of the Administration to maintain and promote hunting opportunities as well. Thus up to 1,100 head of live game were distributed in one year from provincial nature reserves to interested farmers during the past decade, and the number of properties proclaimed as private nature reserves at the request of their owners has risen to 234 with a total area of about 720,000 morgen.

A recent resolution of the Fauna and Flora Advisory Board may be the beginning of important developments in future. This board considered hunting as one of the most important recreational values of game, and concluded, *inter alia,* that it had become the almost exclusive privilege of landowners and their friends; that the hunting facilities for

The Three Rondawels. Proposed Blyde River Canyon Recreational Area.

(Photo: Corrie Roux.)

non-landowners had been drying up fast in adjoining territories as well; and that hunting as a form of healthy recreation with nature had ceased to exist for the South African townsman. In view of the increasing industrialization of our country, the accompanying urbanization of the people, and the expected availability of submarginal agricultural lands for future recreational purposes, the Advisory Board recommended that:—

(*a*) Where possible, sufficient land be acquired to provide hunting opportunities as well; and

(*b*) the Branch should accept, as part of its functions, to supply hunting facilities actively on such *special* state lands.

Although surplus game from the existing provincial reserves is preferably distributed alive amongst those interested, it is still possible to allow limited hunting (e.g. on males that are superfluous even for distribution purposes) at some of them. At others regular youth camps are held (Percy Fyfe), ordinary camping and angling facilities are Provided (Vaal Dam), or daily visits only are allowed (S.A. Lombard and Ohrigstad Dam). As far as possible the principles of multiple use and sustained yields are, therefore, applied to all land under the control of the Branch.

Finally, the Administration does realize the desirability of national co-ordination and planning. It therefore welcomes the establishment of the " Inter-departmental Committee for the Planning and Extension of Facilities for Public Recreation " by the Department of Education, Arts and Science. As an advisory and co-ordinating body this comprehensive committee could render valuable services, but its efficiency could be infinitely increased if it were supported by a permanent " Bureau of Outdoor Recreation " within the same department. Such bureau should not itself control any land, but should assist all the bodies concerned with research, technical aid, national surveys of demand and supply, the acquisition of suitable sites, the formulation of standards, etc. It is trusted that this proposed bureau will be called into being in the near future.

THE "HUMANE COYOTE-GETTER"

Rex D. Janse van Rensburg

BEFORE measures for the control of predators that are harmful to farmers can be applied in practice, it is necessary that careful attention should be paid to such matters as the selectivity, humane action, safety and efficacy of the measures, and to the requirement that they should be inexpensive to use. Only methods and remedies that comply with the aforegoing will ultimately be a real asset in campaigns against farm predators.

Instructed by the Director of Nature Conservation of the Transvaal Provincial Administration, Mr. T. J. Steyn, and with the approval of his colleague in the Cape Province, Dr. D. Hey, I was privileged to attend the demonstrations and experiments of Mr. M. N. Allison of the Bureau of Sport Fisheries and Wild Life of the U.S.A. in the Cape Province in the autumn of the year 1961. Mr. Allison had been invited by the Provincial Administration of the Cape Province and the S.A. Wool Board to demonstrate the use of the " Humane Coyote-getter " locally. This device has been used with great success in the U.S.A. during the past twenty years.

During the period 1st October, 1961, to 31st July, 1962, preliminary experiments were made in the Transvaal Province for the purpose of determining whether the coyote-getter could be successfully used in the control of harmful predators, and to what extent it complied with the requirements mentioned above. The experiments were carried out on thirteen farms in five districts with a total of 364 coyote-getters.

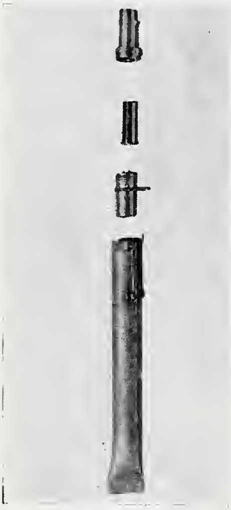
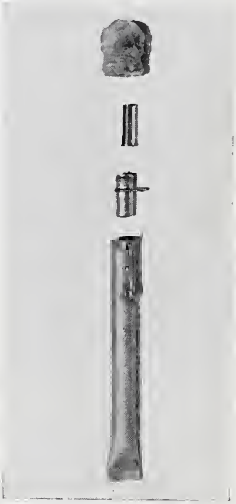


FIG. 1, left.—*Parts of the Coyote-getter.* From below upwards: The stake, the trigger mechanism, the poison cartridge and the head.

FIG. 2, right.—*The complete Coyote-getter.* Note the head with the wool.



Preliminary experiments were done in South-West Transvaal (arid *Cymbopogon-Themeda* veld), North Transvaal (sour bushveld and mixed bushveld areas) and East Transvaal (mixed bushveld area). In these areas farming activities consist of the following:—

Mixed farming inclusive of sheep farming;
Cattle farming;
Irrigation.

The country varied from open grass plains to wooded and mountainous areas. In some of these jackals were plentiful whereas they were scarce in others, as indicated by tracks and other signs. A total of forty-one jackals was destroyed, and although experiments are being continued, the preliminary results are very satisfactory.

Before dealing with the results of the experiments, it is desirable to describe the method.

The "Humane Coyote-getter" (patented) consists of four parts, the stake, the trigger mechanism, the poison cartridge and the head.

The stake is a galvanised metal pipe seven inches long and $\frac{5}{8}$ inch in diameter; the bottom end has been closed by mechanical compression. At the top there is a slit with a small wire spring, and these hold the trigger firmly in position.

The trigger mechanism may be compared with the bolt of a rifle. It is a small tubular device containing a striker, a strong spring and a trigger. This mechanism is cocked by means of a special pair of pliers and is then placed in the open upper part of the stake in such a manner that the trigger fits into the slit and is held in position by the small spring. If the trigger mechanism is pulled out of the stake the trigger is held by the small spring with the result that there is the same action as when the trigger of a rifle is pressed. The strong spring forces the striker violently past the striker's clamp through the opening at the top of the mechanism.

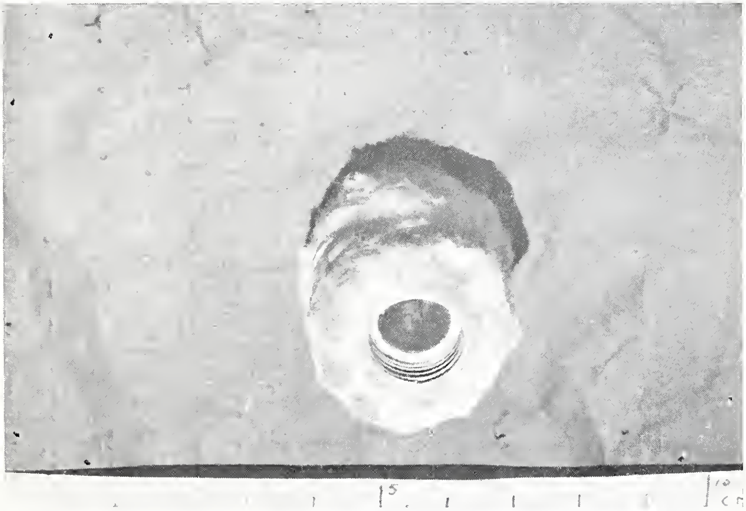


FIG. 3.—*The wrapped head of the coyote-getter viewed from below.* Note the thickness of the wool.

The poison cartridge is a ·38 " special " case with part of the powder replaced by sodium cyanide powder and a yellow dye. This cartridge is closed with sealing-wax to keep out air.

The head of the coyote-getter is merely a short tube into which the poison cartridge fits and which can be screwed on to the trigger mechanism. Wool is tied round the head to look like a large thimble, and the bait is smeared on to the wool. (See Fig. 2.)

If the wad of wool around the head is too thick, the jackal may not be able to take hold of it easily, and if it is too thin, the animal may bite right through on to the metal; if this makes him suspicious he may immediately release his hold. (See Fig. 3.)

It is important that the wool is tied on very securely or else the jackal may pull it right off the head without releasing the trigger and the shot will not go off. Nor must the wool be tied on in a long point, or the jackal may succeed in taking the head of the mechanism obliquely between the teeth, and when the shot goes off the poison may fail to find its way into the animal's throat. A jackal which has had this experience may avoid the bait in future. The layer of wool must be thin enough for the poison to penetrate it easily when the cartridge is fired.

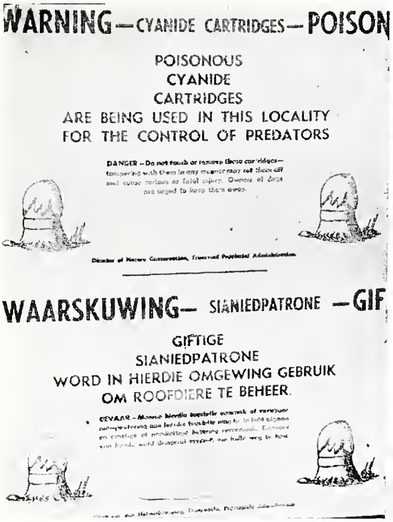
When the coyote-getter is used in wet weather, it is desirable to dip the head with the wool in molten tallow, so as to make it waterproof and to protect the trigger mechanism against water and rust. If the candle grease is not warm enough, it may merely form a thin layer which easily peels off the wool. On the other hand, if it is too warm the wool will become so hard that the animal cannot easily bite into it. Heads that have been treated with tallow show teeth-marks very clearly and indicate what kind of animal took the head.

Unfortunately tallow treated heads are useless in warm weather as the tallow melts and both it as well as the bait drop on to the ground. Jackals will no longer be attracted by it.

The coyote-getter is a very simple mechanism working on a simple principle. The great " secret " is, of course, the bait. This must be of such a type that the animal does not want to eat it as food; and it must not be so evil-smelling that jackals want to roll themselves on or urinate on it. In such cases the bait would be ideal for use on a trap. The bait must have a certain physiological effect on the jackal, that is to say the animal must have the urge to seize the object with its peculiar odour and to run off with it; he must be so interested that he cannot resist the urge.

The desired effect is achieved by mixing different substances with antagonistic properties. The bait consists principally of meat (the kind of meat is important) in a particular state of decomposition. Brains that are also in a particular state of decomposition are added. According to the circumstances, the area and the climate, fresh blood and/or slowly roasted-out fat are added. Beaver castors (the dried anal glands of the N. American Beaver), catnip oil (the oil extracted from the American catnip), and/or musk must also be added. In its final state the bait must have the consistency of a thick syrup. Flies and blow-fles must not be permitted to lay eggs on the bait, since the maggots destroy its odour.

Bait that has been prepared as indicated is definitely selective in its action and mainly attractive for all kinds of carnivores including dogs. (The coyote-getter is the first effective control method for pariah-dogs, which are responsible for a very high percentage of the number of sheep



WARNING—CYANIDE CARTRIDGES—POISON

POISONOUS
CYANIDE
CARTRIDGES
ARE BEING USED IN THIS LOCALITY
FOR THE CONTROL OF PREDATORS

DANGER—Do not touch or remove these cartridges—tampering with them in any manner may set them off and cause serious or fatal injury. Owners of dogs are urged to keep them away.

Director of Nature Conservation, Transvaal Provincial Administration.

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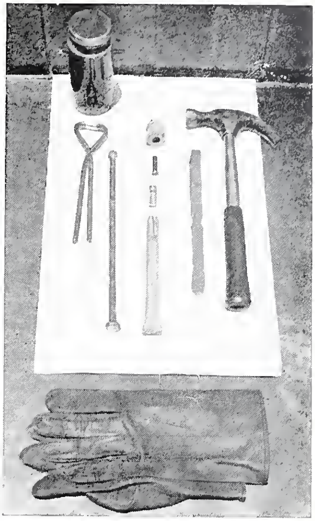


FIG. 4, left.—*The Notice* that is erected on farm gates.

FIG. 5, right.—*Equipment for setting coyote-getters.* At the top the bottle containing the bait. In the middle from left to right: Loading pliers, steel bolt, complete coyote-getter, flag, hammer. Below: Leather gloves.

annually destroyed by vermin in South Africa.) Although the preliminary experiments were carried out on farms stocked with cattle, sheep and goats, no case of poisoning in these animals by the coyote-getter occurred. If the bait has been prepared correctly, no other domesticated animals except dogs will take an interest in it.

It can safely be said that the bait is selective in its action, more selective than any other substance hitherto used in campaigns against predators.

When a decision has been taken to experiment with the coyote-getter in any particular area or on a particular farm, the owner is visited. If he agrees, he signs an indemnity form of the Provincial Administration, thereby indicating that he knows about the danger of the coyote-getter to his dogs.

At every entrance to the farm where experiments are being conducted notice-boards are erected (see Fig. 4). The hunter then carefully examines the area for signs of the presence of jackals and their movements, such as jackal tracks in foot-paths, veld paths, dry water-courses, dongas, river-beds, at open water and places where they creep through under fences, defecating spots and holes in which they may shelter. In this manner the hunter finds out where he must set the coyote-getters.

The equipment required for setting coyote-getters consists of a good hammer, a steel bolt $\frac{1}{2}$ in. by 12 in., a pair of loading pliers, a pair of good leather gloves, a red flag, a bottle of bait and a complete coyote-getter (see Fig. 5).

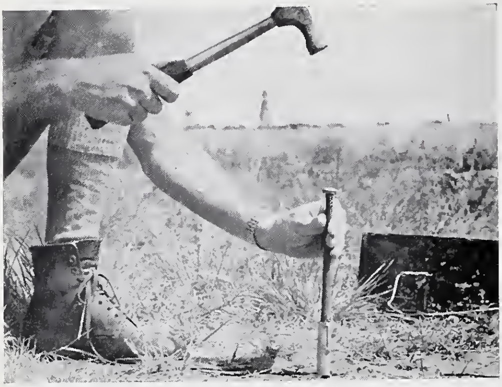


Fig. 6.—The stake is driven into the ground by means of the steel bolt and hammer.

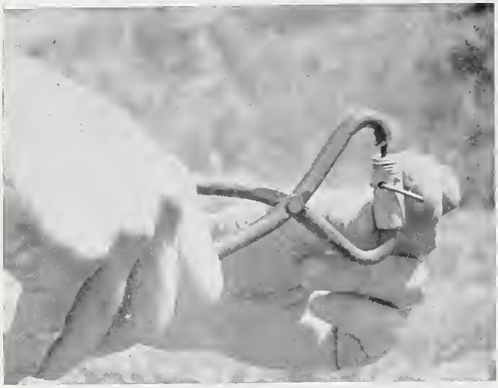


Fig. 7.—The trigger mechanism is cocked by means of the pliers.

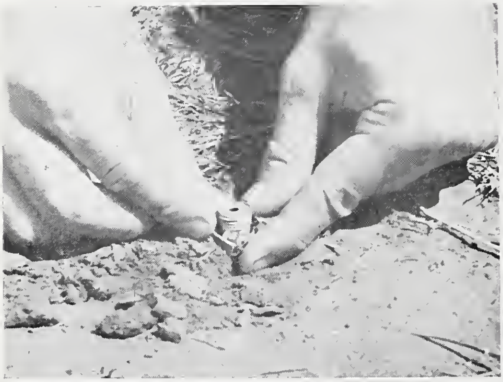


Fig. 8.—The trigger mechanism is placed in the stake.

The stake is filled with sand for about one-quarter of its length and is driven into the ground by means of the steel bolt and hammer until the top is level with the ground (see Fig. 6).

The trigger mechanism is then cocked by means of the pliers (see Fig. 7) and placed in the top of the stake in such a manner that the trigger is held in the slit by means of the small spring (see Fig. 8).

Now the poison cartridge is placed in the head after this has been wrapped in wool.

With the aid of the leather gloves the head is screwed on to the trigger mechanism. A downward pressure on the head must be maintained to avoid accidental firing. While sitting above the wind, the hunter holds the head of the apparatus in the cup of his hand while screwing it on so as to deflect the poison if it should discharge accidentally (see Fig. 10).

A little bait is now smeared on to the head of the apparatus by means of a small stick (see Fig. 11), and the stick is left lying near the coyote-getter. It must not be thrown away, since there is the possibility that the jackal may be attracted to this stick instead of the coyote-getter.

A red flag is fastened on to a tree, bush, shrub or a tuft of grass so that the spot may easily be found. The flag will not disturb the jackal since it is colour-blind. Owing to the overpowering odour of the bait, it is not necessary to take precautions against human scent on the coyote-getter. Repeatedly jackals have been found dead within twelve hours after the coyote-getters were set.

The location of every apparatus is noted down carefully in a pocket-book and on a diagram to ensure that all coyote-getters can be found. According to the number in use, the hunter visits all the coyote-getters every second or third day.

When the jackal comes near a coyote-getter, he is attracted by the bait and seizes the coyote-getter with his jaws. The trigger mechanism is released and the poison shot into his throat. As a rule the animal dies within thirty to sixty seconds; the dye stains the jaws yellow thereby simplifying identification.

A coyote-getter that has been fired is easily recognised by the hole in the top of the head (see Figs. 12 and 13).

As a rule the dead jackal is found within fifty yards of the coyote-getter (see Fig. 14).

Since cyanide acts very quickly causing the animal's death in from 30 to 60 seconds, it is certainly one of the most humane methods of destroying vermin. Only a head shot with a rifle has a quicker action. Hence the animal does not suffer as it would do if caught in a trap or poisoned with other poison, or suspended by fish-hooks or killed by dogs. Cyanide does not result in a chain reaction of poisoning, as it oxidises on exposure to air losing its poisonous property.

In the hands of an inexperienced person the coyote-getter is a dangerous weapon, but a hunter trained in the method can use it with safety. A coyote-getter set in the soil is safe for all animals except carnivores and human beings who might try to tug at the head. It is very unlikely that this will happen, since the odour emanating from it is so unpleasant that no one is likely to want to touch it. If one happens to tread on it, it will not go off, for, as already stated, it is only discharged when one pulls the head. *As far as safety is concerned, one may look upon it as being safer than a trap.*

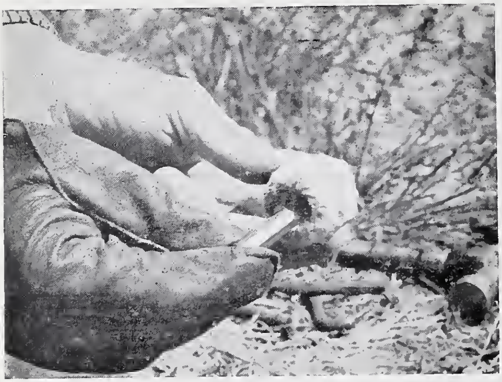


FIG. 9.—The poison cartridge is placed in the head.

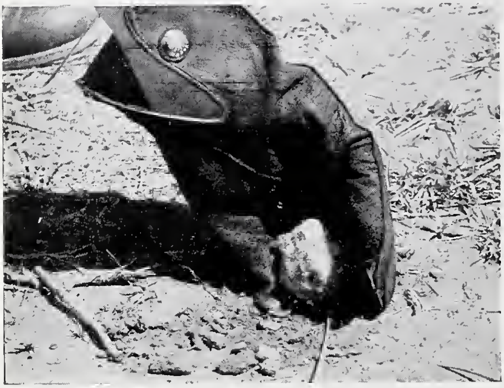


FIG. 10.—The head is screwed on to the trigger mechanism. Note the glove and the position of the hand.

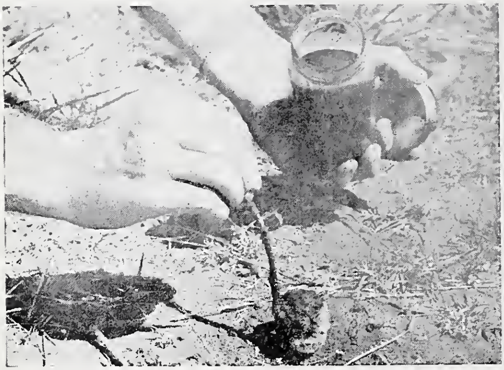


FIG. 11.—Bait is smeared on to the head.

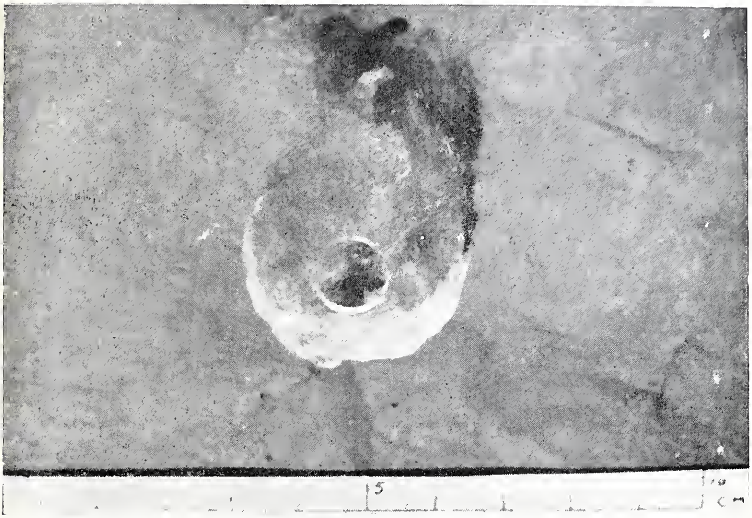
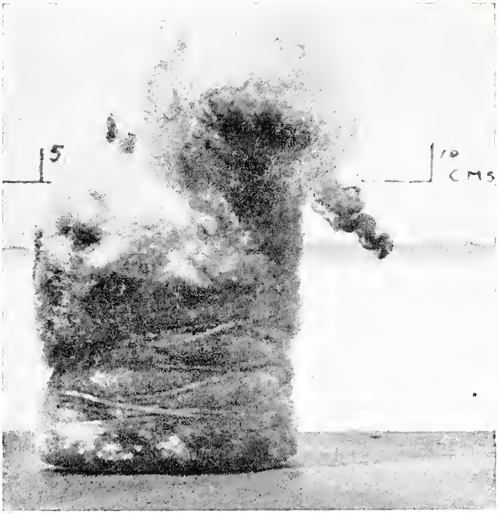


FIG. 12.—A top view of a head that has been discharged.



G. 13.—Side view of the ead of a discharged coyote-getter.

To determine the efficiency of the coyote-getter one proceeds as follows: —

> The number of coyote-getters that have been set are multiplied by the number of days on which they are set; e.g. 10 coyote-getters set in a period of five days give 5 × 10 = 50 coyote-getter days. On the assumption that two jackals were killed during this period, this number of jackals is divided into the number of coyote-getter days in order to ascertain the average number of coyote-getter days required to kill one jackal; thus 50 ÷ 2 = 25 coyote-getter days per jackal in the case cited.
>
> In the same manner the number of dogs in a pack can be multiplied by the number of days on which the pack hunted, and this will give the number of dog-days. Dividing by the number of jackals destroyed, we get the average number of dog-days per jackal, and this is an indication of the efficiency of dogs.

By applying this method to all control methods, it is possible to compare their effectiveness.

During the experiments with the coyote-getter 155 were discharged on a total of 4,540 coyote-getter days and 60 animals were killed, 41 being jackals (20 males and 21 females). Ninety-five discharges without dead animals being found were caused by jackals, mongooses, scarabaeid beetles, monkeys and baboons. The aforegoing figures give the following averages: —

29·3 coyote-getter days per discharge;

75·7 coyote-getter days per dead animal; and

110·7 coyote-getter days per dead jackal.

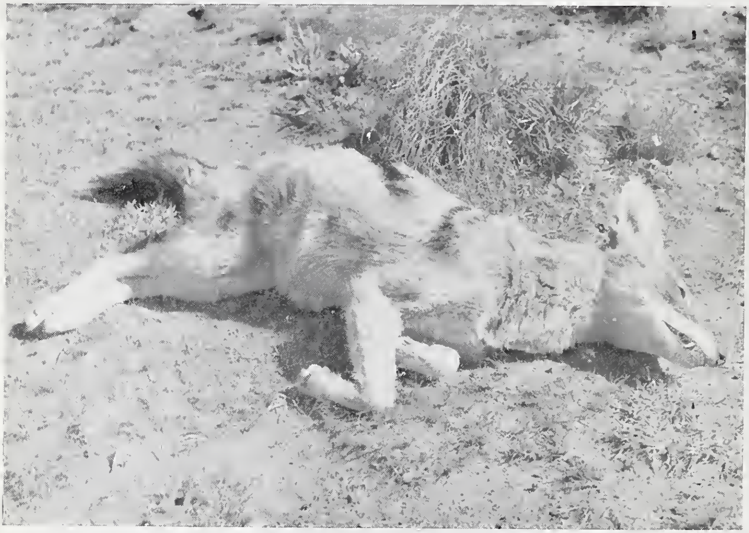


Fig. 14.—A jackal killed by means of a coyote-getter.

The following figures are submitted for comparison: —

> Out of a total of 4,349 dog-days carried out experimentally with Provincial packs of dogs during a period of 22 months in the eastern and western Transvaal, tracks were found and followed up on 170 occasions; 89 animals, 74 of which were jackals, were killed by the dogs. The averages are thus as follows: —
>
> 25·6 dog-days per track found.
>
> 48·9 dog-days per animal found and killed.
>
> 58·8 dog-days per jackal killed.

Other animals destroyed by means of the coyote-getter were 9 mongooses, 5 dogs, 2 genets, 1 Water Mongoose, 1 Aardwolf and 1 Secretary Bird.

A very important factor that must be borne in mind is that the coyote-getter is not limited to any particular type of terrain or particular climatic conditions such as we have in the case of jackal hounds. The coyote-getter can be used in all types of country and under all climatic conditions except floods, hail and snow. There is no damage to fences when coyote-getters are used.

One disadvantage of the coyote-getter is that the cyanide cartridges become ineffective with age, specially in warm weather, when the sealing-wax melts and runs out and the cyanide oxidises and loses its potency. At present tests with a better type of seal are being done in the United States of America, and it is hoped that an improved cartridge will become available in the near future.

As far as its effectiveness is concerned, therefore, it may be said that the coyote-getter compares well with the jackal hound, especially when it is borne in mind that the jackal must be attracted to the coyote-getter, whereas the jackal hounds actively look for the jackals, and also that one person can manage 3,500 coyote-getter days in a week, whereas a hunter with a standard pack of hounds can only manage a maximum of 60 dog-days per week and is dependent upon the weather and the type of country.

Finally a little attention must be paid to the economic aspect. The initial outlay for the purchase of 500 complete coyote-getters and accessories amounts to R315. This supply is sufficient for one hunter and he is able to operate on an area of tens of square miles. Maintenance costs may be calculated at 6½ cents per cartridge used, a little sheep wool, cotton thread for tying on the wool, offal and brains for preparing the bait. The five hundred coyote-getters should be serviceable for a period of at least ten years.

The initial outlay for a pack of twelve trained dogs is R308. But this figure does not include the cost of horses, saddles, bridles, buildings, pots, etc. The maintenance of twelve jackal-hunting dogs is an impressive amount and varies with the diet on which the dogs are fed. It is left to the reader to ponder over this. The average length of service for a pack of dogs is six years.

From the economic point of view, therefore, the coyote-getter is a very cheap method of controlling harmful predators.

At this stage it is concluded that the coyote-getter is a very promising weapon in the war against harmful predators. After further experimentation it will be possible to express a more authoritative opinion.

Cordial thanks are extended to Mr. A. G. Hattingh for the illustrations in this article.

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GAME ON FARMS

W. K. Kettlitz

GAME is kept for various reasons. Some people are interested only in the aesthetic aspect, whereas others incline more to the economic side. But there are many people who are interested in both aspects.

Research on game animals and their habits and requirements in the Transvaal Province and elsewhere in the Republic—and even in the rest of Africa—is a development of comparatively recent date.

When one discusses game with farmers, the following question is sooner or later asked: " how many antelopes can be kept on a morgen of land? ". In the light of present knowledge this question cannot be answered. All that we know is that game animals cannot be controlled like domesticated animals. The carrying capacity of land for game can only be determined in areas where game is actually present. Most farmers are in a position to determine whether there is too much stock on their farms or in any particular camp. If they find that that is the case, it rests with them to rectify the position by removing some of the stock. But it is quite a different problem in the case of game, because it is seldom if ever practical to move the animals; they must live from year to year on the veld where they occur. The farmer's experience with stock is a guide for determining how much game he can keep. This will, of course, differ in different parts of the country.

For game there is at present only one general harvesting period and that is the winter or after the rutting season. The farmer must decide for himself according to the circumstances. Improved refrigeration methods may be found in future that will enable farmers to market venison throughout the year. It will then be a simple matter to harvest any kind of game at the most favourable time.

A blesbok ram.

The farmer is faced with the problem that he cannot easily move his game. But he has this advantage that game does not impoverish the veld to the same extent as domesticated animals, not even in poor years.

Different kinds of game have different requirements. In the case of domesticated animals food and water are the most important. But some kinds of antelopes have additional requirements. Among these territoriality is of importance. Little is know of this, but it is of importance in successful game farming. We know for example that the Steenbok (*Raphicerus campestris*) is not a gregarious animal. As a rule a particular area is inhabited by only one pair. For instance on an area of fifty morgen one will find only one pair. If another pair moves into the same area, the males will engage in combat. Even the progeny of a pair in any particular area must move out when weaned.

The keeping of game in small enclosures is not recommended except in zoos. The areas subsequently indicated for a few kinds of game animals must be regarded as the absolute minimum. The average areas should preferably be ten times as large—the larger the better. When game is kept in small enclosures there is a tendency to treat the animals like pets. Like orphan lambs, game animals may also become bullies specially when reared by hand. The males may cause serious injuries with their horns, even death. Eventually they will have to be destroyed.

The keeping of exotic game animals is strongly discouraged and can only be considered in special cases, as, for example, instances where no indigenous species can exist in the area. If exotic animals succeed in adapting themselves to a new country, they are generally so successful that they oust indigenous kinds and become a burden. One of the best known examples is that of the rabbit which was introduced and liberated in Australia. The House Sparrow (*Passer domesticus*), of which a number was liberated in Durban years ago, is now firmly established in the Transvaal Province.

The keeping of both exotic and indigenous game in the same enclosure cannot be approved. It is also not desirable because the lebensraum for the indigenous species is thereby threatened. In cases where more than one species is kept in the same enclosure, the minimum areas cited later as well as the necessary vegetation and cover must be available for each kind. Provision must also be made for the necessary food, water and cover for all kinds and good fences are a necessity.

It is desirable that water should be provided in the most natural manner. The best way of doing this is by means of small pans with a hard bottom for easy cleaning. The supply of water should be controlled by means of a hidden ball valve. Many kinds soon learn to drink from a trough, whereas others will almost perish from thirst before they will do this. Water troughs must, of course, be designed in such a manner as to satisfy the requirements of the different kinds of animals.

It is highly undesirable to introduce game into areas where they were never found. As our knowledge of the game animals of Transvaal goes back only about a century and a quarter, the former distribution of the many kinds is difficult to determine. If experiments show that game animals thrive in areas in which they did not formerly occur naturally and the local species have disappeared or are unsuitable for farming, it is desirable to try and establish a new kind. There is no doubt whatever that exotic species never occurred naturally in S. Africa and hence they must be considered to be undesirable.

The three kinds of antelopes for which there is the greatest demand at present are the Blesbok, the Springbok and the Impala. The following is a short account of their minimum requirements.

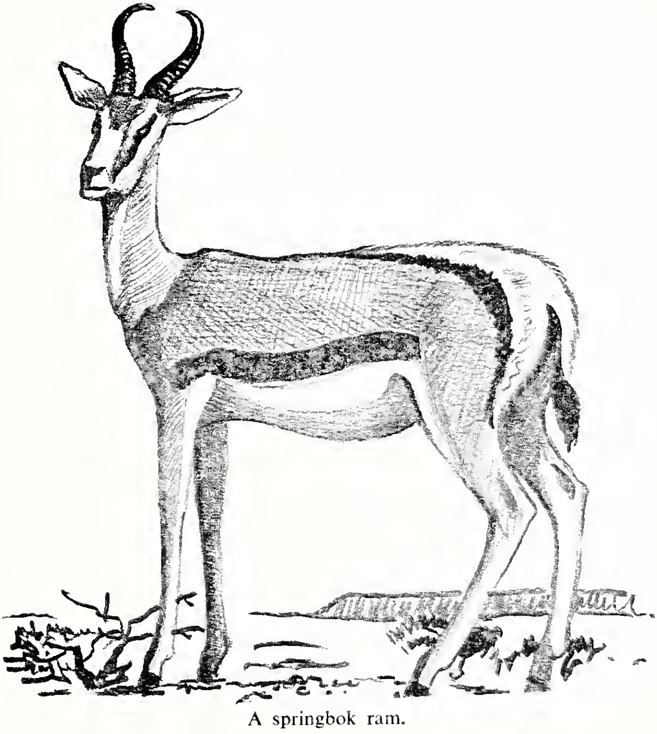
BLESBOK

(*a*) *Minimum Size of the Enclosure:* 50 morgen. Even in much larger areas it sometimes happens that rams chase the progeny through the fences or even kill them. During the rutting season the rams constantly chase one another. If sufficient space is not available, it soon happens that a ram will corner his opponent and kill him. But if the area is large enough, a ram will pursue his opponent for some distance and then abandon the attempt to get to grips with him.

(*b*) *Fence:* The smaller the camp the stronger the fence must be. In a camp of the minimum size the fence should be 4 feet 6 inches high with eight barbed wire strands. It must be built in such a manner that the lower part of 2 feet 6 inches is the strongest. The bottom wire is 4 inches above the ground. Then there are four wires 6 inches apart one with a space of 8 inches and two with spaces of 9 inches. Blesbokke are in the habit of creeping through fences. Once they have learned to do this, they will creep underneath the lowest wire if they can manage to get their horns beneath it. When they have become accustomed to the camp, some of the wires can be removed. When hunted with dogs, blesbokke will break through a strong fence like other antelopes.

When game animals are to be re-established in large enclosures, it is preferable to place them in a small enclosure until they are accustomed to the new environment. If they are then liberated in the large enclosure, there will not be much trouble with the fences.

(*c*) *Pasture:* Blesbokke thrive on almost any kind of grazing; even in very sour veld they will remain in fairly good condition. If their former distribution is studied, it transpires that they were abundant in the mixed grassveld area of the eastern highveld of Transvaal. They prefer short grass. If the grass is too high, it is advisable to let cattle run with them, since these will make the grazing more accessible to the blesbokke. Or it may be possible to cut the grass or practise controlled burning. It must be emphasised that blesbokke, like other ungulates, do not prefer sour grass, but that they can do well on it.



A springbok ram.

In the natural state blesbokke occurred only in highveld areas with the greatest concentrations in mixed veld. Although it clashes with the principles of nature conservation to introduce game into areas in which they never occurred, the Blesbok's case may be treated as an exception, since it is a very adaptable species. It can, therefore, be established in areas from which other kinds of game animals have disappeared.

Heartwater does not seem to be a serious disease for blesbokke. They have been infected with this disease at Onderstepoort but apparently without serious consequences.

They do no harm to crops and even under the most unfavourable conditions will hardly enter a cultivated area.

(*d*) *Cover:* Blesbokke are at home on the treeless plains of the Repubilc but also thrive in bushveld. They seem, however, to be wilder in the latter.

Average market prices in 1961:—

Dead animals, R8.50 each (on the Pretoria market).
Average price for live specimens, R12 each.
Live specimens supplied by the Provincial Administration, R10 each.

SPRINGBOK

Minimum Size of the Enclosure: 50 morgen.

(*b*) *Fence:* Although springbokke are good jumpers, they can nevertheless be kept in a camp enclosed by a farm fence of normal height. Unless forced to do so, they are more inclined to creep through wires than to jump over them. For this reason the fence should be strengthened with additional wires as far as possible. Here also the tenet "the smaller the enclosure the stronger the fence" holds good.

(*c*) *Pasture:* The Springbok's preference for sweet veld is reflected in its natural distribution. It also occurs in mixed veld areas but does not thrive as well as the Blesbok in sour veld. Springbokke subsist on short grass and cannot live on the hard sour grasses. The largest herds are found in the western (sweet veld) areas of Transvaal. Although they also occurred in bush-covered areas like the "Springbok Flats" and the northern Marico district, it is not advisable to introduce them into the bushveld or lowveld because they do not thrive.

(*d*) *Cover:* The Springbok thrives best on open grass-veld but also does well in those partly wooded areas in which it formerly occurred. Sometimes they are very troublesome in cultivated fields and are responsible for damage to maize and fodder. They are not easily caught and the losses are usually high.

Average market prices:—

Dead animals, R4 each.
Average price for live specimens, R12 each.
Live specimens supplied by the Provincial Administration, R10 each.

IMPALA

(*a*) *Minimum Size of the Enclosure:* 50 morgen.

(*b*) *Fence:* Impalas are great jumpers. When hard pressed they will jump over a fence 8 feet high. Normally a 7 feet fence is high enough, but here it is also true that the smaller the camp the higher the fence must be. When impalas have become accustomed to their camp and have sufficient food, water and cover, they will not easily go through an ordinary fence. We have had this experience in the case of an enclosure one hundred morgen in extent with a fence 7½ feet high. The latter was taken down over a distance of about 300 yards and riders and beaters tried to drive them out. Again and again they ran to the boundary but then doubled back between the game drivers.

(*c*) *Pasture:* Impalas like sweet veld and will remain on it until nothing remains. Long sour grass immediately results in a loss of condition. They also browse, and therefore the treeless areas of the high veld are not suitable for impalas; they may succeed in living there but will lead a miserable existence.

(*d*) *Cover:* Impalas make good use of cover in the form of shrubs and trees against cold, wind and frost. Hence the open high veld is unsuitable even apart from the lack of browse. The introduction of impalas into areas where the necessary cover is lacking is not encouraged. In nature impalas occur only in bushveld and lowveld areas; their introduction into other types of veld is not recommended. Under special circumstances impalas may be harmful to green crops in winter. But when they are met with in tilled fields they are generally busy eating green grass or weed shoots between the rows. As a rule the fields lie between their normal feeding-grounds and the river where they are accustomed to quench their thirst. They are no problem in orchards or ripe or half-ripe crops. In general it may be stated that impalas do no harm in cultivated fields.

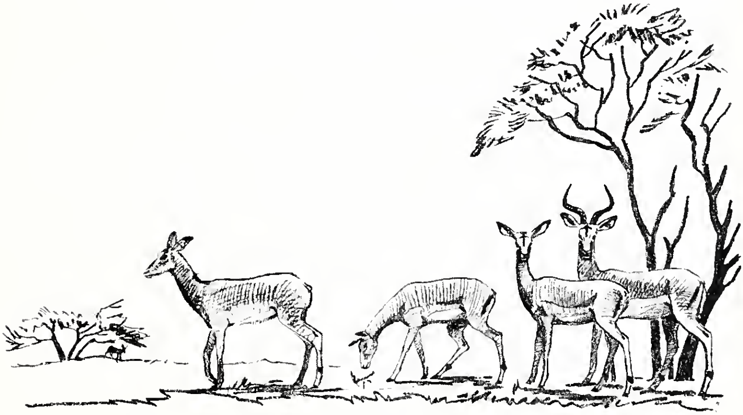
Adult impalas react unfavourably to being captured and transported and should not be caught unless the distance over which they must be taken is very short and they can be boxed singly in crates. The best age for capturing them is four to six months; it is advisable to inject a tranquillizer before they are loaded for transportation.

Average market prices:—

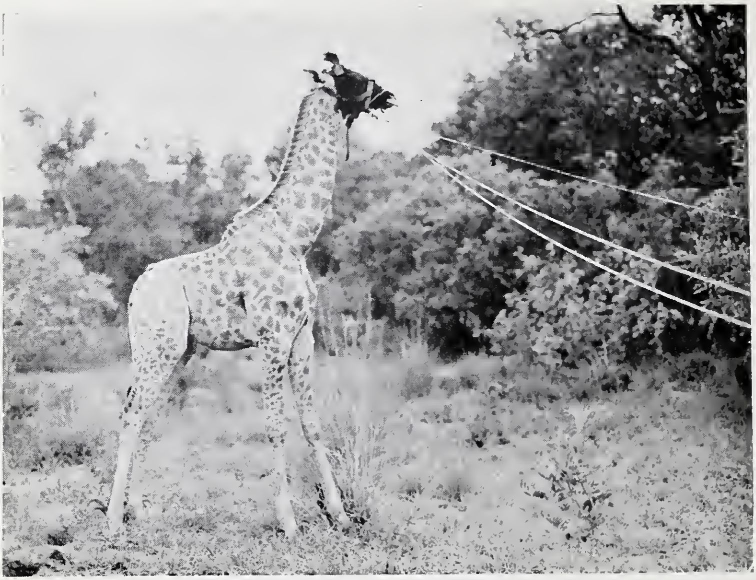
Dead animals, R10 each.

The prices of living animals vary up to R40 each.

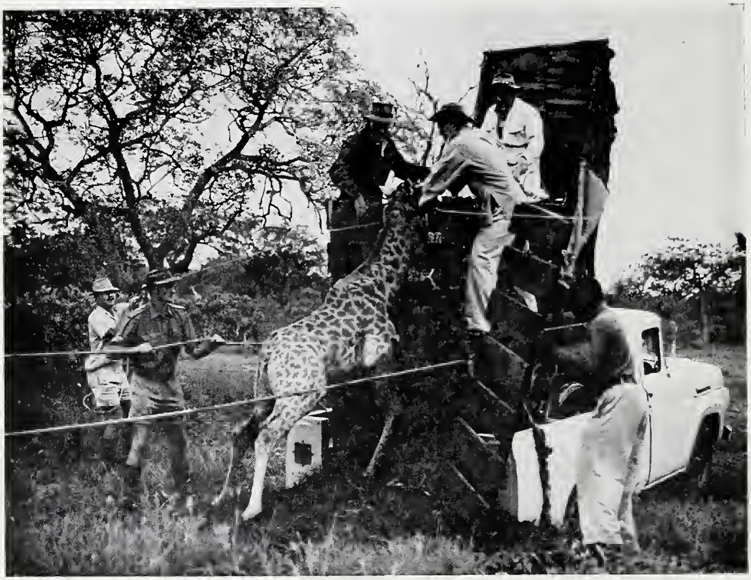
Live specimens supplied by the Provincial Administration, R15 each.



Impalas.



Recently caught and blindfolded.



A young giraffe in the act of being crated.

THE CAPTURE OF GIRAFFES WITHOUT IMMOBILIZATION

W. K. Kettlitz

DURING the past decade much has been published about the capture and removal of wild animals to new areas, especially in the case of antelopes. In such cases use is often made of the new immobilizing methods, in which chemicals are administered by means of darts shot out of guns or cross-bows. As the immobilizing drugs are constantly being improved or new ones are discovered, the capture of wild animals by hand will probably soon be past history.

As recently as two years ago the capture of giraffes by means of immobilizing drugs was still impracticable, and there are still areas in which this new method cannot be applied. Here the old well-known method must be used.

When giraffes are to be captured by hand, it is necessary to have from ten to fifteen horses. It is true that not more than a team of six is used, but a larger number of horses must be available because of the high percentage of injuries.

In capturing giraffes it is necessary to gallop at full speed through the bush, where there may be holes, tree-stumps, branches, thorns or stones at every step. Here only well-trained horses accustomed to the bush and excellent riders can be used. A problem with which one is faced is that some well-trained horses flatly refuse to come near a giraffe and hence are useless for the purpose in view.

Other requirements are a suitable crate, a lorry that can be easily manoeuvred in the bush, giraffe halters, blindfolding cloths, ropes, spades, pickaxes, a platform, a crate and tranquillizers.

As a rule a team of five riders sets out to look for the giraffes. Four are each supplied with a one-quarter inch cotton rope about twenty-five feet long for holding the animal when caught, a blindfolding cloth and a halter. The fifth person carries the tranquillizer and the syringe.

When the giraffes are sighted, the riders proceed carefully step by step in order to get as near to the animals as possible; at the same time they select the most suitable specimen (on account of the difficulty experienced in transporting them and with overhead wires, large giraffes are not suitable for capture). The selected animal is then pursued, and because it is an adept in making sudden turns and in avoiding obstacles in the bush, the riders move in a team. If the chase lasts too long it is discontinued, because the giraffe's knees are likely to be so seriously injured that it has to be destroyed. But if the riders succeed in overtaking the animal, the nearest rider catches it by the tail from his position on the horse. Both rider and horse exert as much drag as they can, whilst another two riders rush to his aid and force the giraffe to stop. Before this happens the rider directly behind the giraffe must give way, since neither horse nor rider is safe behind a standing giraffe that has just been captured.

The giraffe is now held fast while one rider blindfolds the animal and fixes a halter on its head. All this is done from the saddle and sometimes the rider must stand on his saddle to be able to do it. As soon as this has been done, a tranquillizer is injected.

Three ropes are attached to the ring on the halter, and the dismounted riders now hold the animal by means of these ropes, one standing in front and two on the sides. A messenger is sent to the lorry driver who has the crate in order to guide the driver to the spot where the giraffe is waiting.

The animal must not be permitted to lie down; since it is tired and bewildered it seems to lose courage and will not easily get up again.

The giraffe's neck is very vulnerable and easily dislocated. If one has seen how wildly giraffes swing their necks and fight in the pairing season, it is difficult to believe that their necks are so easily injured. Hence the person who holds the animal while waiting for the lorry must be very careful not to exert too much drag. If the animal wants to walk, it is led in a circle. This may be difficult in the bush where the ropes and the animal's long legs are liable to become entangled in the shrubs or trees.

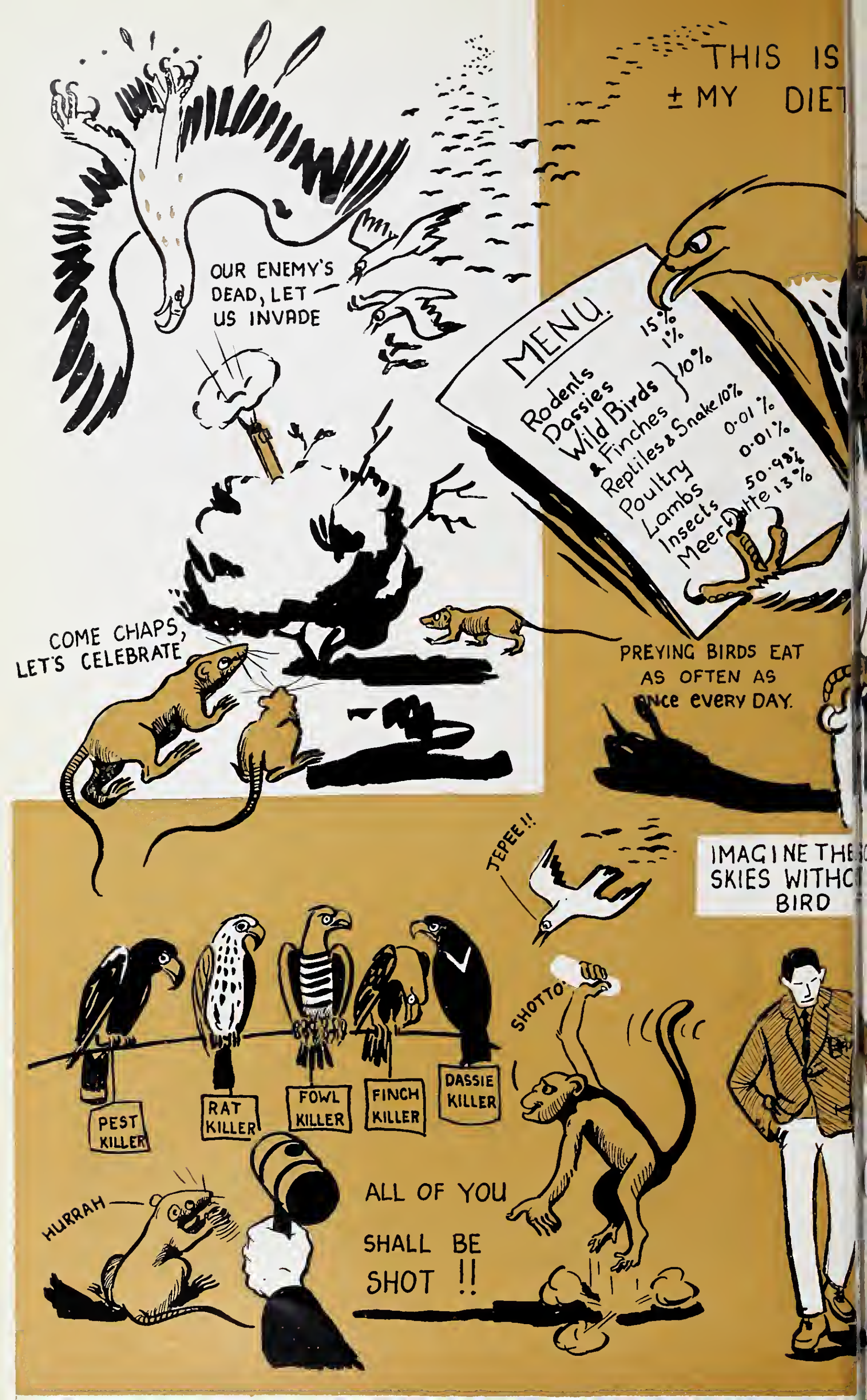
When the lorry eventually arrives, a hole is dug in a suitable spot in such a manner that the back of the lorry can be backed down the slope. A platform is laid down firmly on soil; the object is to avoid frightening the animal when it walks on to the platform.

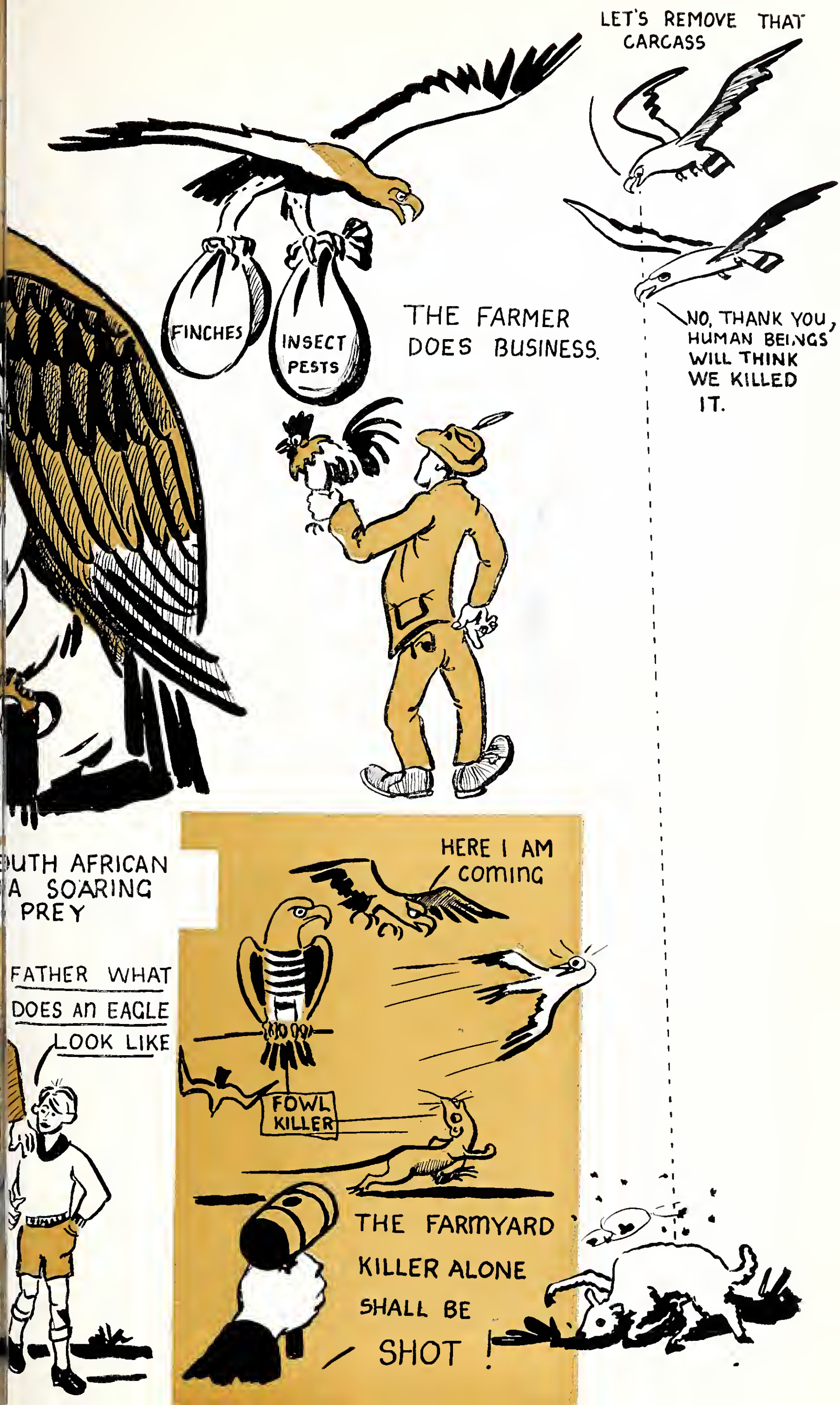
His first bottle of milk.

When everything is ready, the door is removed from the crate and three persons take up their position on the crate, one in front and two at the sides near the back. Ropes are now fixed to form a kind of crush by means of which the giraffe may be led into the crate. The person at the front end takes hold of the middle rope and pulls, whereas the other two assist by means of a rope around the animal's hind-limbs. As soon as the giraffe reaches the platform, the two men at the back of the crate take hold of the halter and lead the animal into the crate. When it is properly crated the front person holds the animal's head in order to prevent it from swinging the head about too much. In the meantime the door is replaced.

Although the giraffe now appears to be safe, it is important that it should not be permitted to lie down. To prevent this a leather belt is fixed underneath its stomach. A bearing-rein is also fixed, so that it may not be able to rear up on the hind-legs and try to climb over the front of the crate or lash with the fore-limbs. Its fore-limbs are just as dangerous weapons as the hind-limbs.

The animal is now taken to its new abode. If the distance is great, it is first kept in a suitable enclosure until completely rested.


THIS IS
± MY DIET
OUR ENEMY'S DEAD, LET US INVADE
MENU
Rodents 15%
Dassies 1%
Wild Birds & Finches 10%
Reptiles & Snake 10%
Poultry 0·01%
Lambs 0·01%
Insects 50·98%
Meer tte 13%
COME CHAPS, LET'S CELEBRATE
PREYING BIRDS EAT AS OFTEN AS nce every DAY.
JEPEE!!
IMAGINE THE
SKIES WITHO
BIRD
PEST KILLER
RAT KILLER
FOWL KILLER
FINCH KILLER
DASSIE KILLER
SHOTTO
HURRAH
ALL OF YOU SHALL BE SHOT !!


LET'S REMOVE THAT CARCASS
FINCHES
INSECT PESTS
THE FARMER DOES BUSINESS.
NO, THANK YOU, HUMAN BEINGS WILL THINK WE KILLED IT.
UTH AFRICAN
A SOARING
PREY
FATHER WHAT DOES AN EAGLE LOOK LIKE
HERE I AM coming
FOWL KILLER
THE FARMYARD KILLER ALONE SHALL BE SHOT !

FLAMINGOES

Dr. T. Farkas

AMONG the most important sights of the Barberspan Bird Sanctuary in the Western Transvaal are undoubtedly the two kinds of Flamingoes that occur there, namely the Greater Flamingo (*Phoenicopterus ruber*) and the Lesser Flamingo (*Phoeniconaias minor*). These birds are sometimes present in thousands at Barberspan. Their bright colours and remarkable body structure attracted the attention of Greek and Roman naturalists from an early date. But nearly two millenia elapsed before modern methods of transportation, particularly by air, provided access to the most important breeding-grounds of flamingoes in East and Central Africa. The first accounts of the huge flocks of the East African brackish waters published at the beginning of the present century not only stimulated the interest of specialists, but through the influence of the press, films and the radio interest was also aroused in much wider circles. It is but natural, therefore, that persons who visit the Barberspan Bird Sanctuary like to admire the colourful flocks of flamingoes that transform the quiet lagoon into a paradise for birds.

Flamingoes occur throughout the tropical and sub-tropical areas of America and Africa and also in Southern Asia. There are even a few small breeding colonies along the Mediterranean Sea in Southern Europe. Six species are known, but only two occur in Africa, namely the Greater and the Lesser Flamingo. Both are found throughout the Republic inclusive of Barberspan.

As the names indicate, the two kinds of flamingoes differ in external appearance. The Lesser Flamingo is about one-third smaller than its greater cousin. There is another character by means of which they can be

Resting flamingoes at Barberspan.

distinguished even at a considerable distance. The predominant white colour of the Greater Flamingo and the predominant pink colour of its lesser relative are conspicuous in the veld, specially when the birds have congregated in separate flocks. From a short distance another difference in colour is noticeable. The Lesser Flamingo's beak is of a ruby red colour, whereas that of the Greater Flamingo is yellow with a black tip. Apart from this the Lesser Flamingo's eye is of a beautiful ruby red colour, whereas that of the Greater Flamingo is yellow.

But of greater importance than the differences in size and colour is the difference in the structure of the beaks of the two kinds, and, in consequence of this, the difference in feeding-habits. The peculiarly bent beak of both kinds is provided with thin horny plates that function like a sieve when the birds look for their food in the water. In the case of the Lesser Flamingo these plates are long and close together (approximately 40 to 50 per centimeter); hence they are able to strain very tiny food particles from the water and pass these back to the tongue and gullet. But in the case of the Greater Flamingo the horny plates are short and not so close together; larger food particules can, therefore, be strained and swallowed. The Lesser Flamingo's food consists chiefly of algae and diatoms; only a small percentage consists of crustaceans and insect larvae. But the Greater Flamingo subsists principally on insect larvae and small crustaceans; such algae and other microscopic food particles as are found in the stomachs have been swallowed by chance. It should be obvious, therefore, that flamingoes do not catch larger animals like small fish. But it may happen that fry and fish eggs are accidentally strained from the water during feeding and thus find their way into the birds' beaks.

The distribution of African and also of other flamingoes is determined by the highly specialised feeding-habits of these birds. The large shallow waters and brackish pans of East and Central Africa, where a very favourable climate is responsible for the production of immense quantities of food throughout the year, are the ideal feeding and breeding-grounds for flamingoes. The result is that there are millions of flamingoes in those areas.

Not only are flamingoes peculiar birds but they also have remarkable breeding habits. They build their nests of mud on the bare sandbanks and islands of the extensive shallow waters and pans. The nests look like stumps that have been cut close to the ground or even like clothes baskets which are somewhat broader below. The egg lies on top. The nests project above the surface of the water and thus the eggs are not exposed to danger if the water suddenly rises a few inches. At times flamingoes also build their nests on rocky islands, where they plaster feathers and bits of plants with mud on top of a rock. Recently Leslie Brown described and photographed such nests on the Elementeita Lake. Equally important is the fact that flamingoes, markedly social in habits as they are, also breed in colonies. A breeding colony may consist of a few hundred nests or of tens of thousands. With the exception of a single breeding colony discovered in the district of Bredasdorp a few years ago, we have no knowledge of breeding colonies in the Republic. It is possible that the nearest of these may occur in the northern part of Bechuanaland, but knowledge of the avifauna of that area is still very incomplete. The large flocks of both kinds of flamingoes that appear in the Republic every year must be looked upon as being temporary guests. After having bred in the north, they move southwards to the numerous temporary brackish water pans in South Africa, where they find a rich supply of food. Due to fluctuations in the amount of food available and the periodicity of breeding and non-breeding periods, there are also fluctuations in numbers in various parts of the Republic. This has also been observed at Barberspan and may briefly be described as follows.

In autumn and the first half of winter flamingoes are scarce at Barberspan, but in September and October more and more birds arrive until the maximum is attained in December. During the latter month, and also in January and February, one generally sees several thousands of both kinds. An important part is also played by Leeuwpan, a shallow periodic brackish water pan only about a mile from Barberspan. When Leeuwpan fills up after good rain, many hundreds of Lesser Flamingoes appear on the scene because they prefer this type of brackish water. The same holds good for the numerous saline and brackish water pans further afield from Barberspan and far beyond the border of the Orange Free State. On the saline mine dams one may see gigantic flocks of the Lesser Flamingo throughout the year.

Many people who live in Welkom are under the impression that the huge flocks at Allan Ridge and other mine dams are descendants of a few pairs of flamingoes that were bred out in an incubator. It is hardly necessary to state that this is not the case. All flamingoes at Welkom and elsewhere in the Republic are visitors from the north. As a rule they remain at one dam for a few days and then move to another. For the most part other flamingoes immediately take their place. It is interesting, too, that the vast majority of flamingoes on the mine dams belongs to the lesser kind. This is due to the fact that only a few kinds of salt-resisting (euryhaline) algae can live in the strongly saline water and are a favourite food of the Lesser Flamingo.

In conclusion a few words must be devoted to the enemies of flamingoes. In the case of the East African breeding colonies, Leslie Brown draws especial attention to the Fish Eagle (*Haliaëtus vocifer*) and Marabou Stork (*Leptoptilos crumeniferus*). Both these birds are very dangerous to young flamingoes. Young chicks and sick or injured adults are caught daily by fish eagles. But the latter cannot really do much harm and are considered to be a natural control factor.

It is quite a different matter in the case of the Marabou. Not only does this ravenous bird devour many eggs and chicks, but when Marabous appear on the scene the flamingoes become panic-stricken and desert their nests. Thus thousands of eggs and chicks perish, especially as the Marabous destroy much more than they can eat. Of the two enemies referred to fortunately only one, the Fish Eagle, occurs at Barberspan. But as flamingoes never breed there, the losses caused by fish eagles are unimportant and practically confined to a few sick birds that the eagles find by chance. Until recently the fish eagles of Barberspan had better opportunities of catching injured flamingoes. A small percentage of low-flying flamingoes always injured or broke their wings against a telephone line near the dam. But since this has been removed, no flamingoes with broken wings have been found.

As the result of this experience, the decision to erect one of Escom's power transmission lines in the neighbourhood of Barberspan was received with mixed feelings. Fortunately the company could be prevailed upon to provide the lines in the neighbourhood of Barberspan with shiny metal plates. These reflect the sun and moonlight very strongly, whereby the birds are warned to fly higher.

In this manner these beautiful and useful birds, which are protected by Provincial legislation, are also protected against unavoidable acts of encroachment on nature. Such measures are simple and cheap to put into practice. The birds can be relied upon to do the rest, since experience has shown that they take their place among those animals that adapt themselves fairly easily to man's activities provided that he is kindly disposed to them.

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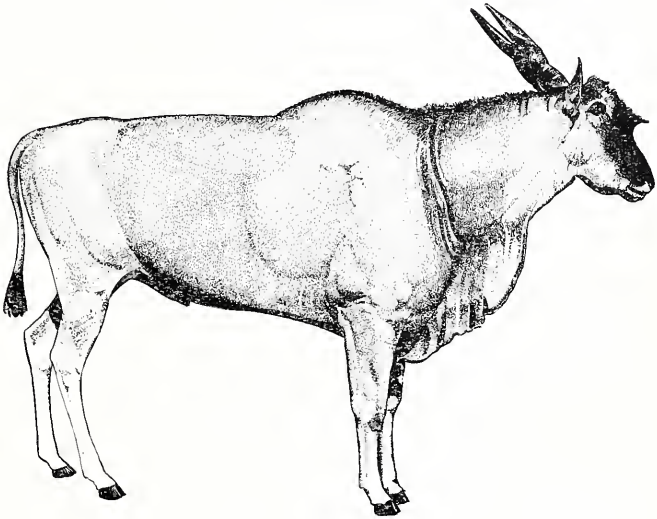
THE MEAT PRODUCTION OF SOUTH AFRICAN GAME ANIMALS

1. The Eland

J. H. M. van Zyl



An eland bull.

LITTLE has hitherto been published about the exact weights and measurements of the various kinds of South African game animals. In view of the greatly increased demand for meat (protein), a knowledge of these matters is essential. Some of the available data are of doubtful origin and some are based on museum specimens. Too often the data are merely estimates, and information about dressed carcases is unobtainable.

For these reasons it was decided about three years ago to start keeping records of the total and dressed weights of carcases, and also of the weights and measurements of the various organs of the different kinds of South African game animals. It will not be out of place to start with the Eland (*Taurotragus oryx*), the country's largest kind of antelope. This mammal, which compares well with the domestic ox not only in size but also in its placid nature, is one of the most suitable species for domestication. Thus Miller (1) writes as follows about the Eland: "Fortunately, it is an easy natured and peaceful animal, and is in fact very tameable. . . . and the eland is considered to be the most fit of all veld animals for fuller domestic breeding. Its flesh is comparable to beef, and it accumulates considerable fat—a rare feature in game animals. Being able to go extended periods without water, and feeding on both grass and bush-browse the eland can put on condition where other animals fail altogether. It would thrive in poor country incapable of carrying ordinary cattle." Stevenson-Hamilton (6) gives a similar description. Even as far back as 1900 W. L. Sclater (5) expressed himself as follows: "The flesh of the eland is always reported to be the best game meat in South Africa, that of the old males being loaded with fat; the hide, too, is much valued for making leather."

With a view to investigating some of these matters in the case of the Eland, especially the production of meat, an Eland ox that reached the S.A. Lombard Nature Reserve on the 10 June, 1952, at the age of nine months was slaughtered when it was 8½ years old. For a period of twelve hours prior to this it had not been fed. The data obtained are given in Table I.

TABLE I.

Carcase weights of the Eland.

	Weight on the hoof	983 lbs.	4 ozs.
	Weight on the hook (the throat was cut)	950 lbs.	4 ozs.
946 lbs. 11¾ ozs.	Dressed weight	586 lbs.	4 ozs.
	Digestive canal (inclusive of contents)	152 lbs.	12½ ozs.
	Offal (head, legs and tail)	72 lbs.	
	Skin	60 lbs.	8 ozs.
	Blood (the throat was cut)	33 lbs.	
	Liver	14 lbs.	9 ozs.
	Lungs	7 lbs.	10 ozs.
	Heart	6 lbs.	4½ ozs.
	Kidneys	2 lbs.	13½ ozs.
	Spleen	1 lb.	15¾ ozs.
	Reproductive organs (inclusive of the bladder, bulbo-cavernosus muscle and fatty membranes)	8 lbs.	10 ozs.
	Adrenal glands		1 ozs.
	Gall-bladder		3½ ozs.

(The exact weights of the adrenal glands and the gall-bladder in grams are 23·8 and 96·5 grams, respectively.)

After the digestive canal and the gall-bladder had been emptied, the weights were as follows:—

Digestive canal: 54 lbs. 12 ozs.

Gall-bladder: 1 oz.

(The exact weight of the gall-bladder is 25·6 grams.)

The data will vary with the area and the seasons. According to Nicolls and Eglington (3) the Eland becomes smaller in size as one proceeds northwards and the colour also varies. The typical Eland in the Republic is tawny-grey to pale brown, whereas the Eland found north of the Zambesi has other colours which Selous (3) describes in the following words: ". . . having nine broad white stripes on each side, and a dark line down centre of back." The Eland's weight on the hoof as given in the literature varies from 1,200 pounds according to Dollman (7) to 2,078 pounds (♂ from Nyassaland) according to Meinertzhagen (2). The weight of the Eland ox under discussion was almost one thousand pounds. Weights will, however, vary with the grazing conditions. In the S.A. Lombard Nature Reserve it has been observed that elands lose much weight during the dry and cold winter months, that is to say during May to August, and that there may even be losses among calves before they have been weaned.

Prior to slaughtering the Eland ox was fed for a month on a reasonably good ration of green lucerne, ground Kaffir beans and ground maize meal. The result was that the meat had an excellent appearance. A layer of fat was present on the hindquarters, ribs and neck; in the latter case the fat was half an inch thick. This agrees with the descriptions given by Miller (1), Stevenson-Hamilton (6) and Sclater (5).

From table I it is clear that about 36½ lbs. of the original weight were lost in slaughtering. This is due to the loss of moisture and blood from the vessels of the entrails.

The Eland ox's dressed weight amounted to almost 59 per cent of the total weight.

It is remarkable that the digestive system forms 15·5 per cent of the animal's total weight, whereas its contents are 9·9 per cent of the total weight after the animal had received no food (except water) twelve hours prior to slaughtering.

The Eland's skin is from 7-8 per cent of the total weight. In a domesticated ox of the same weight the skin's weight is from 6-7 per cent of the total body weight.

It is also clear from the data that about one-quarter of the Eland ox's weight is taken up by inferior products like the digestive canal, reproductive organs, blood, etc.

The dressed carcase yielded the following: —

Weight of hind-quarters—102 lbs., 103 lbs.: Total....	205 lbs.
Weight of shoulders—53 lbs. 8 ozs., 55 lbs. 8 ozs.: Total.	109 lbs.
Rest of carcase....................................	272 lbs.
Weight of wet biltong (cut from the hind-quarters, shoulders and back)	250 lbs.
Rest of the meat obtained from the carcase............	229 lbs. 8 ozs.
Skeleton of the dressed carcase.......................	106 lbs. 12 ozs.

From these data it follows that the wet biltong obtained from the Eland ox amounted to almost 42·6 per cent of the dressed weight and 25·4 per cent of the total weight. The total amount of meat is 82 per cent of the dressed weight and 48·2 per cent of the total weight. The skeleton of the dressed carcase forms 18 per cent of the dressed weight. It is interesting to note that butchers allow 13 per cent for the skeleton of the dressed carcase of a first grade slaughter ox, the remaining 87 per cent being meat. In the case of the Eland the fat and sinews, which are unsuitable for biltong, have not been taken into account. It would seem, therefore, that an Eland ox, especially when slaughtered at an early age, compares very favourably with a domestic ox.

The biltong cut from the Eland was salted with seven pounds of coarse table salt and weighed after it had been left in the pickle for two days. During this time it lost thirteen pounds in moisture. It was then hung up and weighed every fourth day. (See above and Table II.)

Fig. I–Grafiese Voorstelling van die Drogingsperiode.

Fig. I–Graphic representation of the drying period.

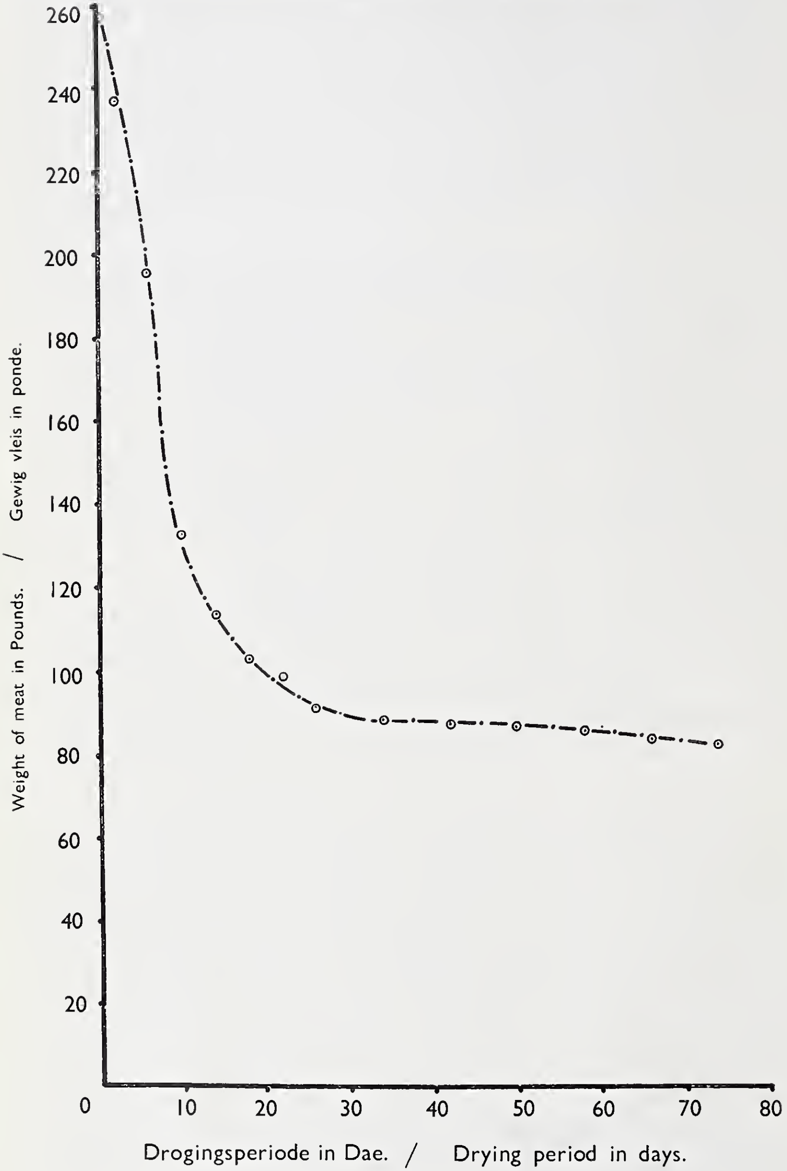


TABLE II.

Loss of Moisture of Eland Meat in the Preparation of Biltong.

Drying periods in days.	Weight of biltong in pounds.	Loss of weight in pounds of the original weight.	Percentage loss of weight of the original weight.
0	257½(+ salt).	—	—
2	237	20½	8.05
6	196	61½	23.95
10	133	124½	48.35
14	114	143½	55.72
18	102¾	154¾	60.09
22	99	158½	61.55
26	90¾	166¾	64.75
34	88½	169	65.53
42	87¼	170¼	66.11
50	86½	171	66.40
58	85¼	172¼	66.89
66	83	174¼	67.76
74	82	175½	68.10

It is clear from table II and graph I that Eland meat is almost completely dry after the lapse of a month. At this stage it was found that the biltong gained in weight if the humidity of the air increased.

The biltong is very palatable, retains its fragrance very well, has an appealing dark-brown colour and retains the correct amount of moisture for a long time to keep it palatable. In fact it is already palatable after two weeks drying when it has lost about 50 per cent of its moisture. In this instance too much salt was unfortunately added for the pickling stage. If the period is reduced to about four hours, the amount of salt used would not affect the flavour adversely.

TABLE III.

Body measurements of the Eland ox.

A.—Length.—

1.	From between the horns to the root of the tail	6 ft.	3 ins.
2.	Length of tail	1 ft.	8½ ins.
3.	From the hump to the root of the tail	4 ft.	1 ins.
4.	Length of head	1 ft.	5½ ins.
5.	Length of neck (from the foramen magnum up to the hump)	2 ft.	4 ins.
6.	Height (from between the horns to the ground)	6 ft.	¼ ins.
7.	Height from the hump	5 ft.	5¾ ins.
8.	Height of the croup	5 ft	1 ins
9	Height of root of tail	4 ft	¾ ins
10	Height of knee articulation	1 ft	4½ ins
11	Height of shoulder articulation	2 ft.	8¼ ins.
12.	Height of hock articulation	1 ft.	10 ins.
13.	Height of thigh articulation	3 ft.	1 ins.
14.	Length of sternum	1 ft.	4¾ ins.
15.	Length of dewlap	1 ft.	6½ ins.

B.—Breadth.—

1.	Neck (from side to side)		8¾ ins.
2.	Mouth (from side to side)		4½ ins.
3.	Chest (from side to side)	2 ft.	2½ ins.
4.	Stomach (from side to side)	1 ft.	9½ ins.
5.	Thighs (from side to side)	1 ft.	9¾ ins.
6.	Breadth of dewlap		4½ ins.

C.—Girth.—

1.	Neck (at about the middle)	3 ft. 3½ ins
2.	Mouth	1 ft. 3½ ins.
3.	Chest (behind the hump and shoulders)	6 ft. 10½ ins
4.	Stomach	6 ft. 1 in.
5.	Thighs	3 ft. 11 ins

D.—Depth.—

1.	Chest	2 ft. 7¾ ins.
2.	Stomach	2 ft. 6 ins.
3.	Neck	1 ft. 2½ ins.

The shoulder height as quoted by various authors shows great variation. Thus it varies from 60 inches (Nicolls and Eglington) to 72 inches (Miller). In the case of the Eland ox dealt with here, the shoulder height was 65¾ inches. It would seem, therefore, as if earlier data can be brought into line with present-day data.

There is also great confusion in the measurements of the total body length. Roberts (4) gives 70 inches whereas Sclater's (5) figure is 122 inches, but he does not indicate how this measurement was made. The total length of the Eland ox described in this article is 75 inches; it was measured from between the horns all along the curves of the back up to the root of the tail.

Work on the Eland, particularly with regard to the calf's development and the production of meat of the adult bull and adult cow, is being continued. Other game animals are also being studied and the results will be published in due course.

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THE FLORA OF THE MERENSKY NATURE RESERVE

M. Gilliland

THE Hans Merensky Nature Reserve, better known as Eiland, is situated in the Eastern Transvaal lowveld about 40 miles east of Tzaneen. The reserve actually comprises the farm Eiland and a portion of Mabete. To local people it is either a nature reserve where game is protected or a pleasure resort because of the thermal spring that is present. Few people think of the reserve as an area where indigenous plants are also protected. They are not protected because they are rare, but as an ecological unit. As civilisation advances, new land comes under cultivation and this necessitates the removal of trees and other indigenous plants. This is a process that started when South Africa was first settled.

The plant and animal life of Eiland will, however, remain a part of unspoiled nature as long as it is kept as a nature reserve. On this area of about 5,000 morgen no inroads will be made on the fauna and flora even though farming operations take their course on the surrounding farms.

Eiland's vegetation is adapted to the sub-tropical climate being a luxuriant green in summer when the rain comes and the heat sometimes is unbearable and withered and dry in winter when temperatures are pleasanter. It would be a mistake, however, to describe the winter as being altogether dry and barren, since many shrubs and trees form evergreen islands in the bush. Where there is water, as for example along the Great Letaba River and at the thermal spring, there are evergreen trees like the Sycomore Fig (*Ficus sycomorus*) and the Sweet Thorn (*Acacia karroo*). If there is sufficient moisture even trees like the Knobthorn (*A. nigrescens*) retain their leaves.

Brackish gully community.

The reserve's vegetation can be divided into four ecological communities. The main community is the Mopani (*Colophospermun mopane*) which is the dominant species. It occurs mostly in low-lying brackish areas and is not common on sandy soil. Plants of the brackish areas form the first community. Two fairly large spruits run through the farm to the Great Letaba River. The Mashovel Spruit runs through the " Black Hills " and the Mamazapi through the thermal spring. The latter spruit is permanent. Three other gullies with many branches and also branches of the two mentioned spruits form a network of brackish areas.

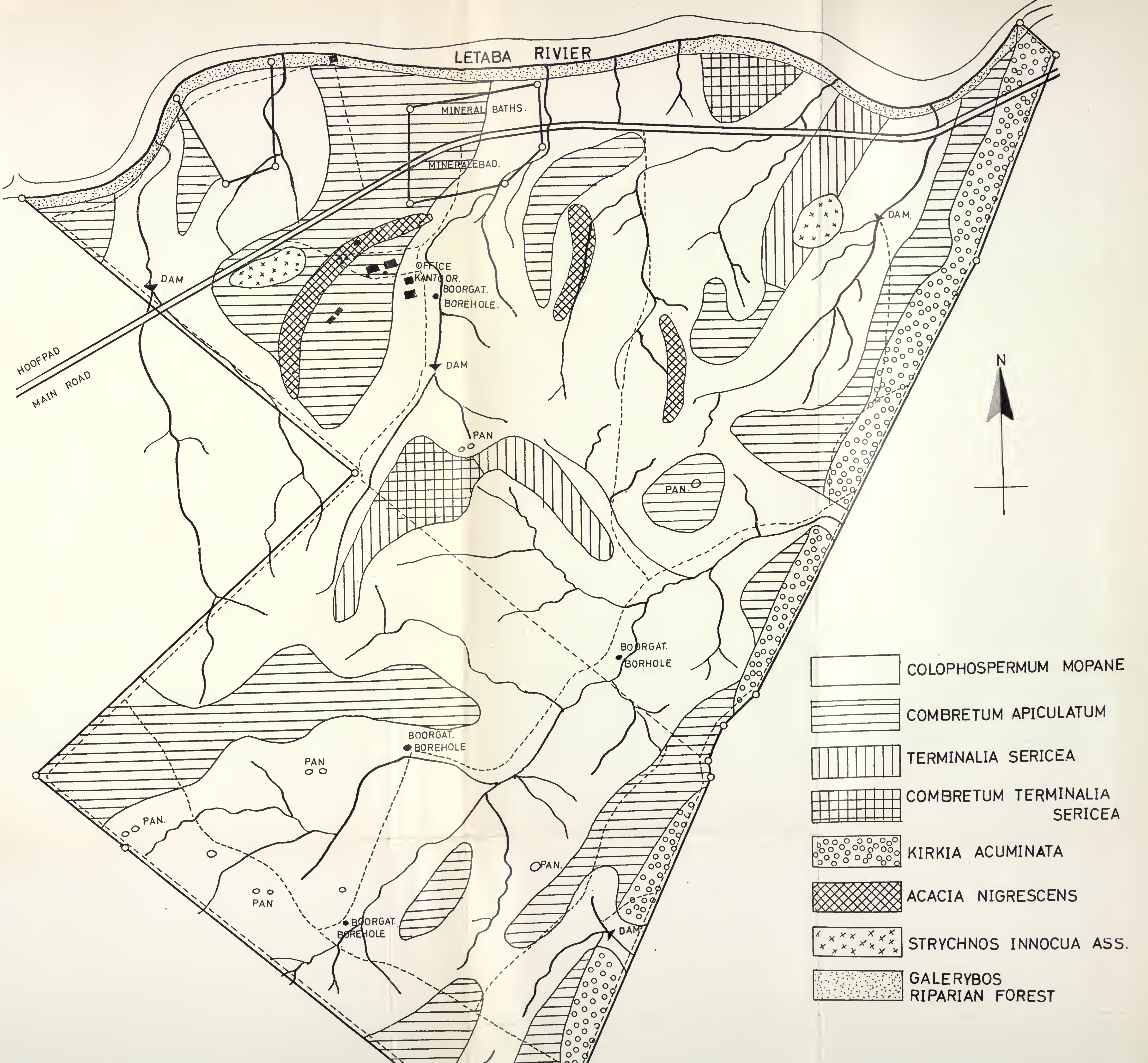
The soils of the brackish areas are rather poor owing to constant erosion of the top soil. Hence a great variety of plants can hardly be expected to grow on them. The Mopani trees generally grow close together along the brackish gullies, the highest trees close to the latter and a few on the brackish areas. The trees become smaller the further they are from the latter until eventually they are mere shrubs that link up with the next community.

The evergreen Gwarribush (*Euclea divinorum*) and the Lemon Thorn (*Mytenus cymosus*) are very conspicuous. They occur on the brackish gullies but are also found between the high Mopani trees. On the flats there is a poor growth of annual grasses like *Aristida barbicollis* and *Eragrostis* spp. Game animals are very partial to these areas because of the palatable grasses. Where there is less erosion of the brackish gullies one finds large patches of the Round-leaf Kiaat (*Pterocarpus rotundifolius*) and African Blackwood or Zebra-wood (*Dalbergia melanoxylon*) between the Mopani. In the summer these areas look like neglected shrubberies, especially when the yellow bean-like flowers of the Round-leaf Kiaat appear.

The Leadwood (*Combretum imberbe*) does not occur in great numbers on the farm, but the largest and thickest are found along the brackish gullies. The large lowveld orchid *Ansellia gigantea* is most often found in the angles of the branches of the Leadwood or the Mopani. This orchid is one of the largest epiphytic orchids and grows mainly on the branches of trees forming a dense mass of aerial roots. When it is in flower in the summer its yellow flowers with brown blotches are a spectacular feature.

A few shallow pans scattered over Eiland may hold water for shorter or longer periods. As a rule they are found on or near to the brackish gullies and are surrounded by Mopani. As the soil of these pans is more fertile due to sedimentation, one finds bulbous plants like the Uintjie (*Cyperus* spp.) and other herb-like kinds in them. Warthogs are fond of wallowing in mud and looking for uintjies.

Between the brackish gullies there are sandy soils at slightly higher elevations. Here the Red Bush-willow (*Combretum apiculatum*) is common and forms the second kind of plant community. The latter must, however, be looked upon as a sub-division of the Mopani community because it occurs among the Mopani and covers a relatively small area. But the Red Bush-willow is the dominant plant in this veld. Associated with it we find other Combretums like *C. zeyheri*, *C. suluense* and the Leadwood (*C. imberbe*). The Silver Terminalia (*Terminalia sericea*) is found in limited numbers among the species mentioned. Less conspicuous but nevertheless well represented in the community are the Marula (*Sclerocarya birrea*) and Bakhout (*Lannea discolor*), which are the largest trees in the community. Here the Red Bush-willow and the Silver Terminalia seldom exceed twenty feet in height.



Vegetation Map of the Hans Merensky Nature Reserve.

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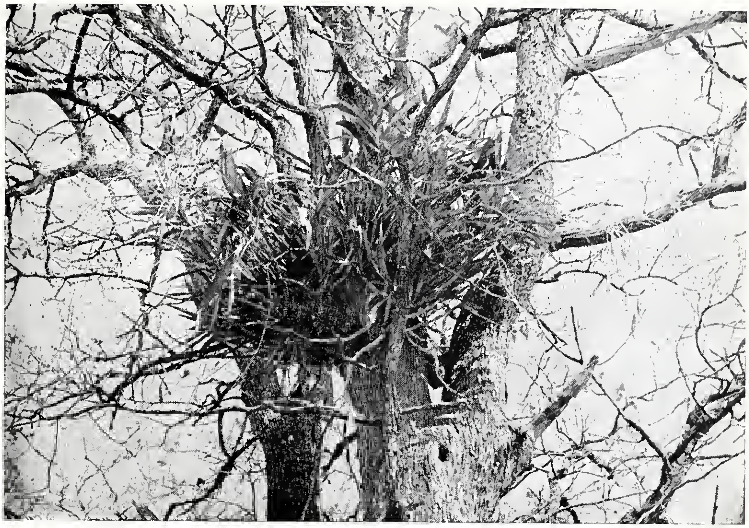

Ansellia gigantea in the branches of a mopani tree.

Two shrubs found in the Mopani community also occur in smaller numbers. They are the Zebra-wood and the Round-leafed Kiaat. Much more widely distributed on the sandy ridges are *Grewia monticola* and *Pavetta assimilis.* The Torchwood (*Balanites maughamii*) also assumes the form of a shrub; it is found particularly in the area around the Black Hills. Torchwood can grow to a considerable height and is of special interest because of its relationship with the Dubbeltjie (*Tribulus terrestris*). Natives use the bark to catch aquatic animals by stupefaction.

Rock outcrops and termite mounds have specific plants growing on them. They are considered to be minor groups of the red bush-willow community. The outcrops are not large and are partly hidden by the sandy soil. Here we find the Monkey-Orange (*Strychnos innocua*) and sometimes the White Seringa (*Kirkia acuminata*) and the Long-tail Cassia (*Cassia abbreviata*). Both these trees are always found in the vicinity of rocks or rock outcrops. The long-tail Cassia has remarkably long pods.

Capparis tomentosa and *Maerua caffra* are found only on rock outcrops but are not plentiful. In the rainy season they are almost completely covered with flowers that resemble powder-puffs and are then a beautiful sight. They are closely related to the Witgatboom (*Boscia albitrunca*) which is well known as a fodder tree.

Termite mounds are of special interest because of their specific vegetation. The old mounds are generally not occupied by termites and are as a rule completely grown over with a grass known as *Botriochloa pertusa.* One or both of two kinds of trees regularly found on the mounds are the Tree Fuchsia (*Schotia brachypetala*) and the Transvaal Ebony (*Diospyros mespiliformis*). The former is not plentiful in the reserve, but a few specimens are mostly present in the northern part. It is a conspicuous tree with clusters of red flowers that produce so much nectar that it drips from

Kirkia acuminata trees near the Black Hills.

Part of the Black Hills with typical vegetation of the area.

the flowers. The latter generally appear in October. The Transvaal Ebony is abundant with its greatest concentration on the banks of the Great Letaba River.

The red bush-willow community has a very dense ley of different kinds of grasses and furnishes the best grazing for the game. The grasses are a mixed community without any definite pattern. The commonest are Red Grass (*Themeda triandra*), *Brachiaria deflexa, Smithia bulbosa, Panicum maximum, Cenchris ciliaris* and *Eragrostis superba.*

Eiland's northern boundary is formed by the Great Letaba River and here we find the third kind of plant community, a riparian forest community. Most of the plants along the river-banks are evergreen kinds whereas the vegetation of the flats and the brackish areas is deciduous. The riverine vegetation is also known as gallery forest and is divided into two groups because that of the river-bed and sand-banks differs from that of the river-banks and also from the vegetation on numerous islands in the river.

In the river-bed we find the huge Sycomore Fig growing at the water's edge. Between these trees and not so well shaped we find the Bush-willow (*C. glomeruliflorum*) and the Mingerhout (*Adina microcephala*). These two kinds as well as the Water-Berry (*Syzygium guineense*) are generally found somewhat higher up on the river-banks. Shrubs do not occur under the Sycomore Fig, but frequently the ground is covered with creeping grasses that remain green because of the moisture and are a great attraction for species like the Waterbuck and the Bushbuck.

The Common Reed (*Phragmites communis*) is the most abundant plant and grows on the sand-banks right up to the water's edge. Only the rushes compete with it.

Combretum community.

The dense vegetation on the river-banks is impenetrable in parts. The Transvaal Ebony is the most plentiful kind of tree and grows so densely that few other kinds can find a foothold. This tree is overgrown with climbers of various diameters. The green thorny climber *Acacia schweinfurtiana* forms a dense impenetrable mass along the edge of the river. Other lianas like the Cross-berry (*Grewia caffra*) and the Lucky-bean Climber (*Abrus precatorius*) are also fairly plentiful. The liana *Cissus quadrangularis* with its four-angled green stems climbing up against the tree-trunks has aerial roots and drapes itself over the branches. It is not only found at the river but occurs throughout the reserve.

In the main river-bed many parallel channels are eroded by the recurrent floods. It is in these channels that the Mingerhout, the Waterberry and the Wild Date Palm (*Phoenix reclinata*) are most plentiful. The latter also grows in the Mashovel Spruit.

Riparian forest or gallery forest. Large wild fig-trees (*Ficus sycomorus*) in dense forest at the river's edge.

Where the Transvaal Ebony is less abundant along the river, we find trees like the Leadwood, the Lance Tree (*Lonchocarpus capassa*) and here and there a Knobthorn. Odd specimens of the Natal Mahogony (*Trichilia roka*) and the Tree Wistaria (*Bolusanthus speciosus*) are met with on the river-bank. The latter tree is also found along spruits and in the brackish gullies. In places where the spruits join the river or where there is a fair amount of moisture in the ground the Tambotie Tree (*Spirostachys africanus*) is present. The latter is seldom found at a distance of more than a quarter of a mile from the river; groups may be seen at the thermal spring and the western gate.

The reserve's eastern boundary is demarcated by a dolerite dyke, a series of low ridges and rocky koppies consisting of dolerite. They are known as the " Black Hills " and are a specific habitat for the characteristic vegetation found on them.

Perhaps the first tree to catch the eye is the White Seringa with its characteristic white trunk and widely spreading branches. In the same manner as the Transvaal Ebony fringes the Great Letaba River, so the White Seringa may be said to fringe the Black Hills. This tree is found throughout the eastern part of Eiland up to where the Black Hills peter out on farms south of the reserve. It is a conspicuous tree in summer when it is clothed with a pale green foliage. In autumn it is also attractive when the foliage assumes reddish-brown and yellow colours before the leaves drop off. Few other kinds of plants grow underneath this tree except grasses like *Hyparrhenia dissoluta*, *Brachiaria* spp. and herbs like *Wormskioldia schinzii* and *Commelina africana*, and there are but few of these.

Part of the trunk and root system of Smuts's Wild Fig (*Ficus smutsii*) on the boulders of the Black Hills.

High up in the hills we find *Euphorbia cooperi* characterised by its long trunk and candelabra-like crown of branches. The trunk lengthens as the old branches fall off and new ones develop on the crown. Together with the Euphorbias between the piled up rocks there are species like Smut's Wild-Fig (*Ficus smutsii*), the Cape Wild-fig (*F. capensis*), *Sterculia rogersii* and the Transvaal Carrot-Tree (*Steganotaenia araliacea*), all of which grow in cracks between the rocks. Their roots penetrate these cracks, finding their way into the smallest imaginable spaces. As they thicken by growth they split the rocks apart.

Many of the shrubs found on the flats also occur on the koppies albeit in much smaller numbers. Such are *G. monticola* and the Round-leaf Kiaat. Other shrubs like *Croton gratissimus* and *Holmskioldia tettensis* occur only on the summits of the koppies. In the summer *H. tettensis* is a beautiful shrub densely covered with a mauve coat of umbrella-like blossoms. The calyx as well as the corolla is of a mauve colour, but the darkly coloured corolla soon disappears whereas the flimsy calyx persists for some time.

With the exception of the White Seringa and the Euphorbias other trees and shrubs are also covered with lianas, but these differ from those found along the river. Many kinds of wild grapes (*Rhoicissus* spp.) the Wild Potato (*Ipomea* sp.), Wild Cotton (*Gossypium herbaceum*) and the Wonder Plant (*Tineospora fragosum*) are found here. But the latter, which is able to produce new roots without being dependent upon a substratum, is very scarce.

At the base of three of the smaller rocky koppies on the boundary between Eiland and Mabete, there is a small group of Impala Lilies (*Adenium multiflorum*) associated with *Sansevieria* sp. Impala lilies are very beautiful in winter when they are a mass of white and red flowers. On Eiland they are seldom higher than two feet because impalas and kudus eat the leaves, flowers and stems, but under protection they may attain the height of small trees.

With the exception of a number of *Mesembrianthemum* species, aloes, cotyledons, *Kalenchoë* and stapelias are not present in the reserve. But some miles further *Aloë van der merwii* occurs. Stapelias are found across the river in the Bantu area.

In the reserve there are areas that do not find a place among the plant communities already dealt with and that cannot be raised to the status of a separate community. Such are the turf soils on which we find Knobthorn trees growing in a semi-circular arrangement. Owing to the presence of sand the turf is not very obvious, but as a rule the Knobthorn is met with on turf or dolerite outcrops.

Plant succession on one of the old and abandoned ploughed fields.

Before the farm became a reserve, it was occupied and farming was practised. Evidence of this may still be seen where buildings were erected and land cultivated. But there has been no ploughing for about twelve years and hence the vegetation is gradually returning to the original state by means of the circuitous path of plant succession. On abandoned ploughed land we find Sickle Bushes (*Dicrostachys glomerata*) and *D. nyassana.* Many young Knobthorns, Mopanis and to a lesser degree Leadwood trees are crowding out patches of *Ormocarpum trichocarpum.* It is hoped that the areas concerned will return to the natural state by way of the secondary succession.

The vegetation around the dams that have been made already shows a tendency during the first year to return to the natural condition. In one of the newest dams a pioneer like the Water-fern (*Marsilea macrocarpa*) has been observed, whereas water-lilies have already appeared in the older dams.

The reserve's vegetation does not differ from that of the surrounding country, but with such means as soil conservation and fire-breaks the reserve will be kept in the natural state both for its fauna and flora. It is expected that areas that have been disturbed by man will revert to the original state in the course of time, so that the reserve will continue to exist as an island (=Eiland) of virgin environments.

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INTERESTING FEILD OBSERVATIONS

Feeding-habits of the Martial Eagle

During the first half of March, 1961, when the springbokke in the S. A. Lombard Nature Reserve began to lamb for the second time in the season, we were kept very busy with catching lambs. The latter are caught for prospective "game farmers", whose object is to bring game back to areas in the Transvaal Province from which it has disappeared. The catching procedure simply consists of locating lambs in the veld and following them for shorter or longer distances in a vehicle until they lie down or are near enough to be caught.

A martial eagle attacks a springbok lamb.

On one occasion a springbok lamb a few days old was followed for about a mile when it lay down. The motor vehicle was stopped at a distance of about eight feet from the lamb. At the very moment that one person had alighted to catch it, a young Martial Eagle appeared like a bolt from the blue and pounced upon the lamb with much swishing of the wings. Although the lamb's instinct of self-preservation came into play, the eagle succeeded in burying a claw of its right foot deep in the lamb's back (subsequently a post-mortem examination revealed that the muscles of the back had been pierced and that the claw had penetrated the abdominal cavity). The eagle held on with all its strength and beat its wings furously as if its object was to reduce the lamb's speed by a dragging effect. Under such circumstances it is difficult to judge distances, but we who witnessed the incident estimated that the bird managed to retain its hold for probably more than fifty yards, when it was unceremoniously shaken off by the lamb.

At a speed exceeding forty miles per hour we were now able to follow the fleeing lamb and the pursuing eagle and managed to catch up with some difficulty after about a mile. The eagle flew about a foot above the lamb and close behind it. It tried frequently but unsuccessfully to grasp the lamb's back. Even after we had reached the animal the eagle refused to abandon its efforts. Although we were close behind the lamb and tried to scare the eagle away by shouting, the bird merely changed its position and remained just beyond the reach of our waving arms, which it ignored. Several times it stooped at the lamb up to about a foot and flew horizontally as it tried to grasp the lamb. But the little antelope was now running so fast that the eagle gave up its efforts after a distance of about one and three-quarter miles. Flying in wide circles high into the air, it watched us as we again tried to catch the lamb.

Soon after this the lamb was caught in a state of exhaustion; it died three hours later.

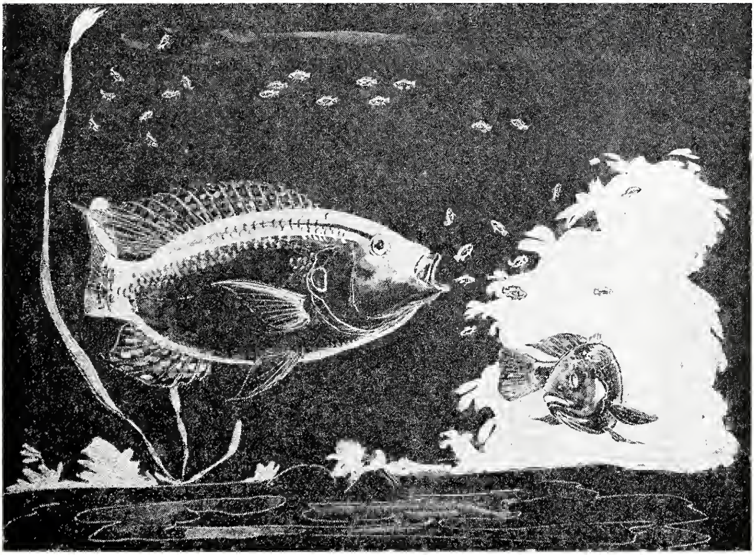
In October of the year 1959 two martial eagles were met with soon after they had caught a rock or white-throated monitor (*Varanus albogularis*). The birds had already devoured the entrails. They flew away when the observer arrived, but soon returned after he left and devoured most of the lizard. Only the skin and parts of the skeleton such as the skull and backbone remained.

In November, 1961, just after good rains had fallen, a Martial Eagle was seen to drop its prey from the air. After closer investigation it seemed to be a ground squirrel (*Geosciurus inauris*). The eagle, apparently in a playful mood, picked its prey up again and dropped it a second time. When the observer came nearer to investigate, the bird flew away and did not return.

P. A. ELOFF, A. G. HATTINGH, J. H. M. VAN ZYL.

Sparrman's Kurper

During my employment at the Jonkershoek Fisheries near Stellenbosch some specimens of Sparrman's Kurper bred in the aquarium. When the fry hatched, the parents had great difficulty in controlling the brood as they swam about in the tank.



Sparrman's kurpers with fry.

On one occasion, as I approached the tank to observe the specimens at close quarters, I noticed that the parents were very alarmed because a large enemy was coming so near the little ones. They failed to realise, of course, that there was thick plate glass between us. When I came too near to their liking, one of the two parents out of desperation began to collect the little fish in the mouth. This unexpected action apparently did not suit the little fish at all, since they made every effort to escape from the parent's mouth. When the latter found that it could not accommodate them all, it merely ejected them and the process started all over again.

As I had studied the breeding-habits of this interesting fish not long before this, I knew that it is not a mouth-breeder. But this observation may throw some light on the manner in which kurpers like *Tilapia mossambica* and *Chetia flaviventris* came to carry their eggs and fry in the mouth.

S. S. du Plessis,
Professional Officer, Pretoria.

A Careless Water Mongoose

One day as I left Jonkershoek near Stellenbosch on my way to some Bantus who were working in a garden near Eerste River, I spotted a Water Mongoose which was quite unaware of my presence as it walked through dense shrubs at a distance of about fifty yards from the Bantus. I stood perfectly still as I watched the animal. While looking in the direction of the Bantus every now and then, it walked across an open space straight towards me. Right in front of me it sat down in the morning sun and began to lick itself. There was a large tick on its neck.

In my hand I had an orange-tree leaf which I now dropped to see what would happen. The animal trembled with fright but remained where it was and continued with its toilet while keeping a watchful eye on the Bantus. After the lapse of about a minute it got up, smelt the tip of my shoe and walked away leisurely disappearing in the shrubs.

I am of the opinion that the peculiar behaviour of the mongoose can only be explained by assuming that it associated the human odour with that of the Bantus who were at a safe distance.

S. S. du Plessis,
Professional Officer, Pretoria.

The Strength of a Hippo Bull

One day I came upon two Hippo bulls fighting at the confluence of the Olifants and the Steelpoort River. They were so busy tackling one another that I was able to observe them at close quarters. One of the two had already received serious injuries from his opponent, and it seemed as if he would lose the fight. Suddenly the other bull lifted the injured one about three feet out of the water by means of a tremendous blow; he was suspended in the air for a moment before falling back into the water with a loud thud on the flat of his back.

Fighting hippos.

If it is borne in mind that a Hippo bull may weigh up to 5,800 pounds (1). there can be no doubt about the incredible strength of this animal.

F. J. du Toit,
Nature Conservation Officer, Pietersburg.

Age of a Kudu Bull

A kudu bull.

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(1) Meinertzhagen, R. (1938). Some Weights and Measurements of Large Mammals. Proc. Zool. Soc. of London, Vol. 108, Series A.

In the year 1940 Mr. P. J. van Nieuwenhuizen purchased a farm known as Platlaagte. An unusually large track of a kudu bull caused by an abnormality at once drew his attention. This animal drank regularly at a spot near the farm-house and became fairly tame as the years went by. He was, of course, nicknamed " Grootspoor ". The animal was full-grown.

During July of the year 1960 this particular kudu was shot by a nephew on the farm Drieberge about three miles from Platlaagte. There was no doubt that the animal was " Grootspoor ", and he was, in fact, recognised immediately. On account of his age he had particularly long horns and could also be recognised by his very slender build. It weighed only 150 pounds after having been cleaned.

It is clear, therefore, that this kudu was more than twenty years old.

D. F. Potgieter,
Nature Conservation Officer, Marble Hall.

A Tame Impala

Mr. Sarel Mathee of Parma had a tame Impala ewe that used to move about without restraint. Immediately prior to the shooting-season in 1961 the animal disappeared. After the lapse of ten months she turned up again and was just as tame as ever. She could be stroked and seemed to recognise Mrs. Mathee, to whose calls she responded. After a month at home she dropped a lamb.

I. Viljoen,
Nature Conservation Officer, Sibasa.

An Impudent Bushpig

In the year 1941 we were living at the Entabeni Forest Station in the Zoutpansberg District, where my father was working.

A bushpig helps itself to young domestic pigs.

One night we were awakened by a commotion in the pigsty. My father and I went to investigate and found that a Bushpig (*Potamochoerus porcus*) had devoured several piglets. The domestic pig sow was trying to protect her offspring, but had the worst of it and sought refuge in a corner of the sty. Before anything could be done the robber disappeared.

J. Willemse,
Senior Nature Conservation Officer, Pretoria.

A Tame Springbok

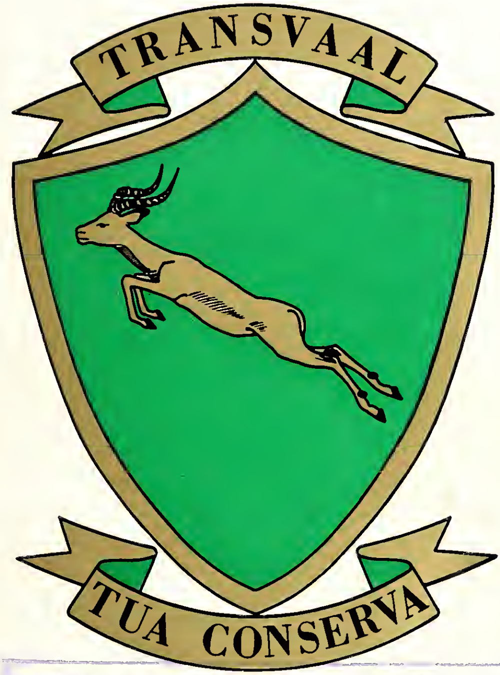
Mr. Percy Fyfe of the Percy Fyfe Nature Reserve relates that when he and his brother were boys they had a hand-reared Springbok (*Antidorcas marsupialis*) on their farm in the Orange Free State.

This Springbok had adopted the farm dogs as its mates and followed them wherever they went. It even slept with the dogs.

Whenever Mr. Fyfe and his brother went out to hunt hares, the Springbok, of course, also accompanied them. If a hare was found, the Springbok pursued it together with the dogs. As the antelope was a faster animal than the dogs, it caught up sooner with the hare. It would then hamper the hare until the dogs arrived.

J. WILLEMSE,
Senior Nature Conservation Officer, Pretoria.

Square-lipped rhinos in the Loskop Dam Nature Reserve.



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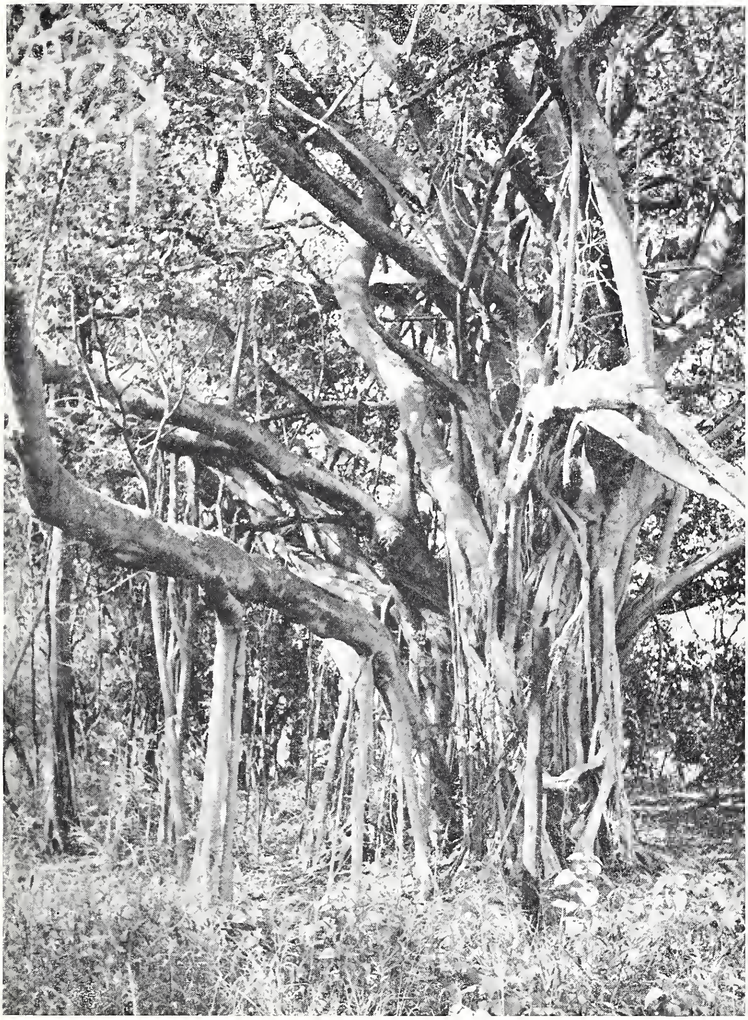
We are grateful to those friends who have helped us with photographs.



A fine specimen of the wild fig-tree *Ficus burkei* in the Loskop Dam Nature Reserve. The fig-tree has grown around and killed a Wild Seringa tree.
Photo: Chris Pisart.

TRAINING IN WILDLIFE MANAGEMENT

T. J. Steyn

WILDLIFE management has been a specialized occupation for many years. Even the biologist with a sound training in basic subjects such as zoology and botany soon came to realize that there was a serious deficiency in his training. On the one hand much of his accumulated knowledge was of little value; on the other he felt a real need for methods and techniques that would be applicable to his daily problems. In general he had too much theoretical and too little practical training at his disposal.

As time went on, quite a number of courses were developed overseas in order to provide specially for the needs of the wildlife manager. Thus, for example, a total of 279 Bachelor's, 71 Master's and 19 Doctor's degrees in different aspects of wildlife management were awarded at 32 universities and colleges in the U.S.A. in the year 1949. As the need for this type of training was more generally realized, even the emergent African states (mainly with foreign aid) started paying serious attention to it. The University College of Rhodesia and Nyasaland at Salisbury established a post-graduate course in Wildlife Management as from the beginning of 1964. A "College of African Wildlife Management" was opened at Mweka, near Moshi, Tanganyika, on 23 June 1963, while a second training centre for the French-speaking regions is being planned in West Africa.

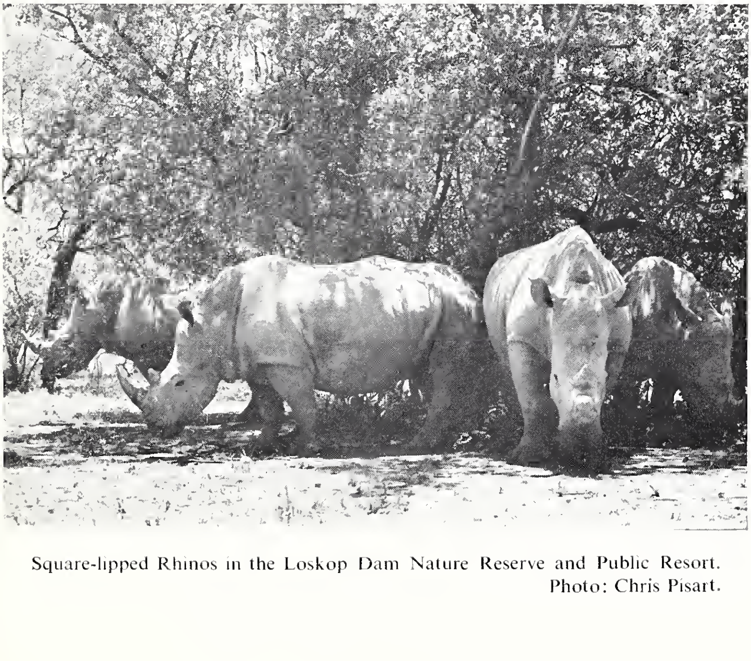
In South Africa also attention has been given to the introduction of a course during the past three years, *inter alia* by the National Co-ordinating and Advisory Committee on Fauna Research, which was appointed by the Hon. Minister of Agricultural Technical Services in April 1960. This Committee reports good progress with its scheme, and it is hoped that an important announcement concerning the financing of the same will be made in the near future. It would be a pity if South Africa, containing some of the finest wildlife conservation areas in the world, should fall behind in the field of training.

The Extermination of the Square-Lipped or White Rhinoceros (*Ceratotherium simum simum* (Burch.)) In Transvaal and its Reintroduction.

A Historical and Critical Review

Dr. R. Bigalke

IN his treatise on the Mammals of South West Africa, Shortridge (1934) states that a horn figured by Parsons (1743) is the first record of the White Rhinoceros. Sclater (1900, I, p. 299) also includes this reference in his list of literature. As there was some doubt about the validity of Shortridge's statement, Mr. R. W. Hayman of the British Museum kindly looked up the reference for me. In a letter dated 21 May, 1963, he writes that the greater part of Parsons' article deals with what earlier writers wrote about the Indian Rhinoceros that reached Lisbon in 1513 and that was figured in an exaggerated manner by Dürer (in the year 1515; Gowers, 1950, and a subsequent note with illustration). After having commented on the inaccuracies in Dürer, Parsons devotes several pages to a detailed description of an



Square-lipped Rhinos in the Loskop Dam Nature Reserve and Public Resort.
Photo: Chris Pisart.

Indian Rhinoceros brought to London in 1739. At the end of this article he points out that the African Rhinoceros has two horns, *but he does not describe or name any African rhino.* On plate III of his paper he has nine separate figures illustrating various parts of the rhinoceroses known to him, including separate horns. Figure 6 has the caption "A beautiful Horn in Dr. Mead's Museum, being about 37 inches long". But it is not indicated where this horn came from. The supposition that it might be the horn of a Square-lipped Rhinoceros seems to be based only on its length. Since, however, the anterior horn of the Black Rhinoceros (*Diceros bicornis*) may exceed 37 inches in length (Best, etc., 1962), there is nothing to show that the horn figured by Parsons is indeed that of a Square-lipped Rhino. It is clear, therefore, that the claim that the earliest record of the Square-lipped Rhino is that of Parsons must be rejected.

In the years 1797 and 1798 John Barrow went on a journey into the interior of South Africa and published an account of his travels in two volumes. In the first volume (1801) he writes as follows: "In our descent of the mountain we were driven to seek shelter from the violence of the rain in a mixed horde of Bastaards and Namaaquas. The chief was of the former description. In his younger days he had been a great lover of the chace, and his matted hut within still displayed a variety of the skins of animals that had fallen before his piece. He boasted that, in one excursion, he had killed seven camelopardales and three white rhinoceroses. The latter is not uncommon on the skirts of the colony behind the Hantam mountain, and seems to be a variety only of the African two-horned rhinoceros. It differs from it in color, which is a pale carnation, in size, which is considerably larger, and in the thinness of its skin; all of which may perhaps be the effects of age."

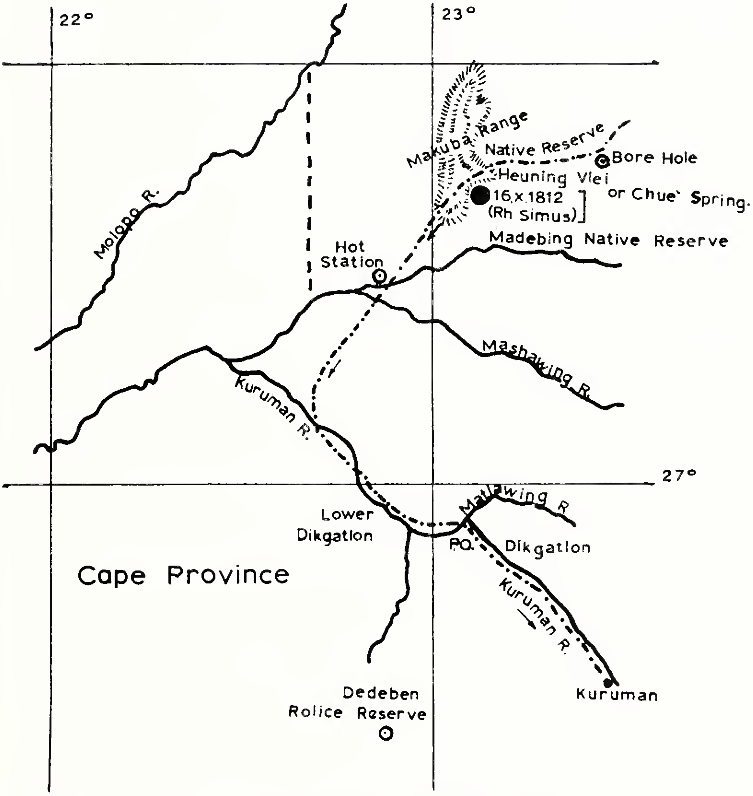
A full-grown Square-lipped Rhinoceros is indeed a larger animal than a full-grown Black Rhino, but Barrow does not make it clear whether he saw any of these so-called "white rhinoceroses" himself or had any personal knowledge of the animals. The strange body colour that he mentions suggests that this was not the case, and it is clear from his account that he is uncertain of the animal's identity. Hence it can neither be claimed that the rhino referred to by Barrow was *Ceratotherium simum simum* nor that it formerly occurred in Namaqualand. Shortridge (1934) points out that there seems to be no authentic record of the occurrence of *C. simum simum* anywhere south of the Orange River.

The Square-lipped or White Rhino was first recognised as a new species and described scientifically by W. Burchell (1817) in a French journal. He came across this huge mammal for the first time on the 16th October, 1812, in what is now the Northern Cape Province in the locality of Chué Spring or Heuningvlei (app. Lat. 26° 15′ S, long. 23° 10′ E) on the Makuba Range about eighty miles north-north-west of the town of Kuruman (see the accompanying map after Cave (1947)). Burchell's accurate drawings, now the property of the Gubbins Trustees in Johannesburg, have been published in Cave's paper. As the records of both Parsons and Barrow must be rejected on account of the reasons already given, the year 1812 must be accepted as the earliest reliable record of the presence of the Southern Square-lipped Rhinoceros (*C. simum simum*) in South Africa.

The object of this article is to try and establish when *C. simum simum* became extinct in Transvaal. For this purpose it will be necessary to examine the historical records as far as they have a bearing on this matter.

From the accounts of the early hunters and travellers, it is clear that the Southern Square-lipped Rhinoceros was formerly widely distributed over southern Africa. It was found in what are now Southern Angola, part of

South-west Africa, Bechuanaland, Southern Rhodesia, Transvaal, Zululand and at least a part of Portuguese East Africa. It is generally accepted that it did not occur south of the Orange River. Bryden (1893) doubts this but does not have any satisfactory evidence in support of his opinion. It has been doubted whether the animal formerly occurred in what is now the Orange Free State. Kirby (1920, p. 224) states that evidence is not wanting that it once ranged far south of the Vaal River, but unfortunately he does not furnish the evidence. Selous (1899, p. 53) is of the opinion that there is no reason why some Square-lipped Rhinos should not have crossed the Vaal River into the Orange Free State at certain times of the year. In view of this opinion, a recent communication from Dr. A. C. Hoffman of the National Museum in Bloemfontein is of special interest. In a letter of 4 July, 1963, he states that about two years ago he received a fine skull of *C. simum simum* that had been found in the Vals River near Kroonstad in the Orange Free State, that is to say in a tributary of the Vaal River. The museum also has parts of a semi-fossilised skull received many years ago from Fauresmith in the south-western Free State.



Map redrawn after Cave (1947, with a corrected name) showing the type locality of *Ceratotherium simum simum*.

In 1893 an imperfect skull of a Square-lipped Rhino was dug out of black peaty soil at a depth of eight feet about twelve miles from the Vaal River in the Kimberley district. Sclater (1900, p. 302) claims that this is the southernmost locality recorded up to that time. There seem to be no subsequent records of non-fossilised remains having been found further south. Sclater does not state whether this skull was found on the northern or southern side of the river, and unfortunately the present director of the S.A. Museum can shed no light on the matter. But in the Surveyor-General's map of the Cape of Good Hope and neighbouring territories published in the year 1895, one finds that most of the northern and the whole of the western boundary of the Kimberley district was at that time formed by the Vaal River; at no point did the northern or western boundary extend beyond this river. There can be very little doubt, therefore, that the skull mentioned by Sclater was found on the *southern* side of the Vaal River.

Heller (1913) as well as Player and Feely (1960) have published maps showing the general distribution of the White Rhino in Africa in former times. That part of Heller's map that shows Southern Africa and gives a number of actual records is reproduced here. It has been redrawn on a larger scale and the present names of the territories have been substituted. Player and Feely's map differs somewhat from that of Heller on the southern and eastern sides.

Selous (1899, p. 54) says that when he first visited South Africa in 1871, the range of the White Rhinoceros "had been very much reduced since the days of Cornwallis Harris, but these animals were still numerous in the uninhabited districts of Matabeleland, Mashunaland, Gazaland (i.e. southern Mozambique—author) and Zululand, as well as certain portions of the Eastern and South-eastern Transvaal". In the same account (p. 58) he writes that although it "has always been known that a few white rhinoceroses still survived in a certain district of Northern Mashunaland, I think it is generally believed that by 1890 this species had become extinct in every other part of South Africa".

In his book entitled "Game and Gold", the date of publication of which is not furnished but may have been 1926, Glynn writes as follows (p. 56): "During the interval between the first and second Sekukuni wars, my father and I decided to go down to Pretorius Kop, and on the 25th June, we set out for the hunting grounds with some Boer friends". As the first Sekukuni War ended on 15 February 1877, and the second war started in February 1878 (Theal 1919), the date of departure of the hunting expedition was 25 June 1877. Glynn continues: "Black rhinos were killed by us on the opposite side of the Crocodile River, where Nelspruit Station is today, and white rhinos were in the country low down on the Sabie River on the edge of the Matemere Bush". In another passage (p. 113) he writes that "black rhinos were found in the rough country down below White River, Nelspruit and extending across the Oliphants River; there were a few white rhinos also."

Kirby, writing in 1896 (p. 9), says that "both species of rhinoceros are now practically extinct, the square-mouthed being altogether so". In a footnote he gives the following additional information: "For many years past the well-known Matamiri bush, lying along the south bank of the Sabi River, has been a favourite resort of *Rhinoceros simus*, but they have become almost extinct now even there. This year (1895) I came upon two in that district, a cow and big calf; but they are decidedly rare". He has a further reference to the animal in Appendix I of the book (p. 550), where he writes that "with the exception of perhaps three or four individuals still lingering in the Matamiri bush to the south of the Sabi, the square-mouthed rhinoceros (*R. simus*) is also extinct in this district". The latter statement seems to contradict the previous one, but as he thanks Dr. Sclater, Secretary of the Zoological Society of London, "for the assistance rendered in connection with the scientific portions of the work (p. x)", it is possible that a considerable interval elapsed between what he wrote in the appendix and the statement in the body of the book, namely that the Square-mouthed Rhino was altogether extinct in the Matamiri bush in 1896.

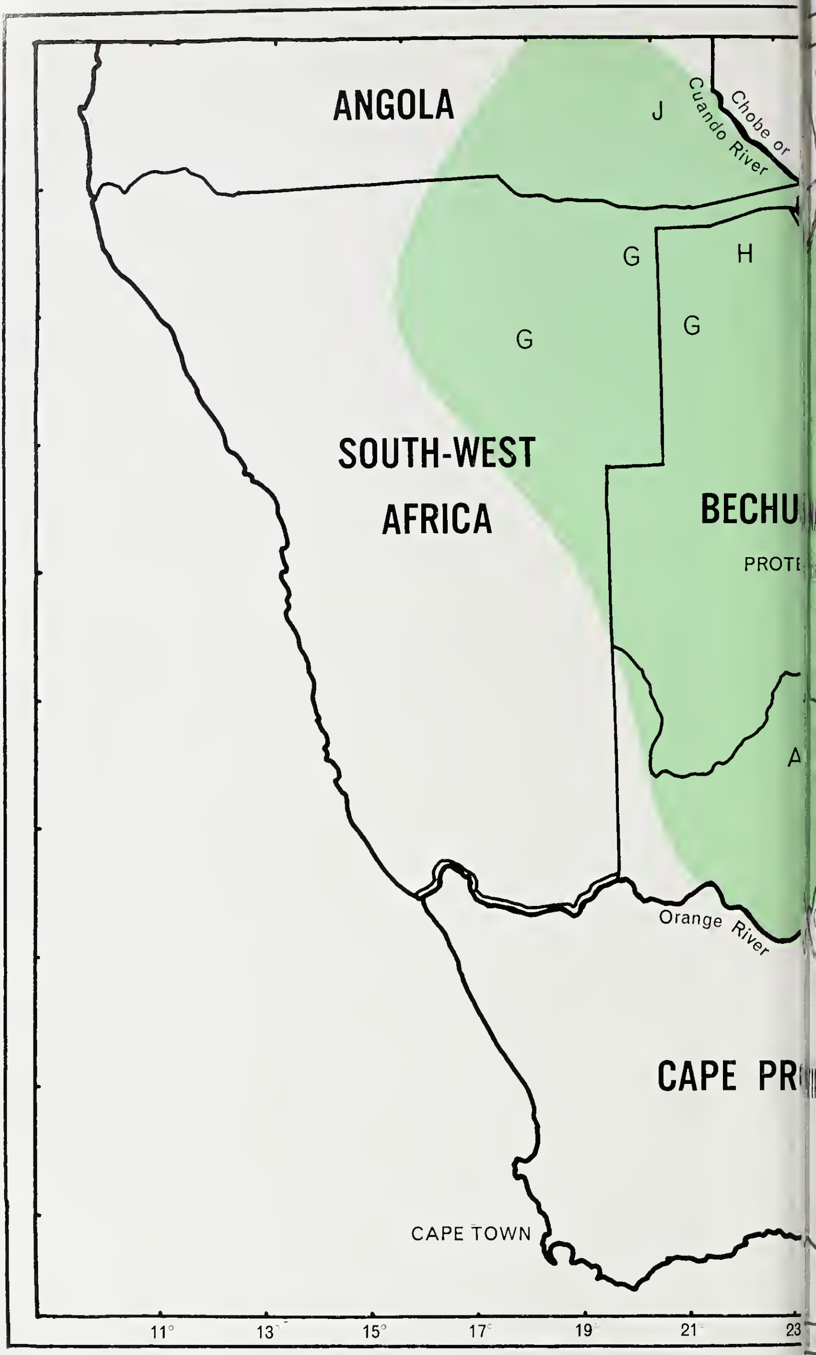
Before proceeding with this account, it is necessary to say something about the spelling of Bantu geographical names. Anyone who delves into the writings of the old hunters and travellers in Africa is soon struck by the variation in the spelling of names, with the result that it is sometimes difficult to recognise the various spellings used for any particular place. The fact that Bantu orthography has not yet been fixed may lead to confusion. Thus the "Matemere bush" referred to by Glynn as being "low down on the Sabi River" is undoubtedly the same that Kirby refers to as the "Matamiri bush". "Matamiri" was used for a long time but has recently been changed to "Nwatimhiri". One can only express the hope that finality of spelling has now been attained. In the low veld of Transvaal confusion becomes even greater when names that have appeared on the maps for a long time are replaced by new ones. Thus the Mbabat River has now become the Timbavati River.

Another difficulty is the use of the same names in different parts of the subcontinent. Thus the Sabi River (now spelt Sabie) in the Eastern Transvaal is a tributary of the Komati River, but there is also a Sabi River in Southern Rhodesia flowing through Mozambique (where it is the Rio Save) directly into the Indian Ocean at Nova Mambone. Such matters must be borne in mind when old books are consulted about the former distribution of Africa's wild life.

In a recent paper Pienaar (1963, p. 23) states that "according to Glynn (1926) a few (i.e. Square-lipped Rhinos) remained near Lower Sabi until the later 'seventies' ", but I cannot find any statement in Glynn's book to this effect. The sentence seems to be quoted from Stevenson-Hamilton (1950). Pienaar omits Glynn's reference to the "Matemere Bush", but quotes Hamilton who says that the White Rhinoceros certainly did not exist after the seventies of the last century (that is to say in what is now the southern part of the Kruger National Park—author). It must be emphasised that Stevenson-Hamilton did not reach the low veld of Transvaal until the year 1902, by which time this animal had already disappeared. Hence he had no personal knowledge of the status of the fauna in that area prior to that year. In point of fact he refers to Glynn's book and to what W. Sanderson told him (1950).

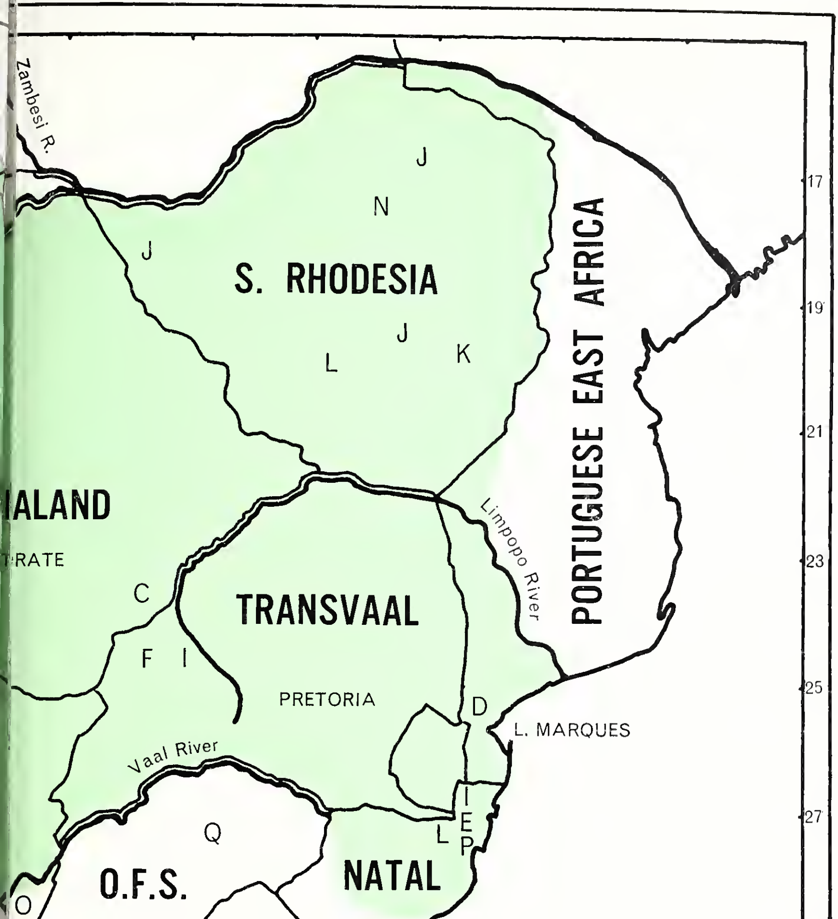
In a letter (1 May 1963) Pienaar informed me that he omitted any reference to what Kirby wrote in 1896 about the presence of the Square-lipped Rhinoceros in the "Matamiri Bush", because he has grave doubts about the reliability of Kirby's observation and believes that the animals seen by him were Black Rhinos, and also because the presence of a cow and calf in 1895 implies the presence of other full-grown animals, especially bulls. But Kirby's statement cannot be rejected on these grounds. Rejection is only valid if proof can be furnished to show that his observation was in fact based on a mistaken identification. Such proof is lacking.

Kirby was an experienced hunter, and there can be no doubt that he was well acquainted with both the White and the Black Rhino. While lamenting the death of two brave and devoted Bantu hunters (1896, pp. x and xi), he states that they had hunted together for *nine years*. He wrote another book in which he gives an account of hunting trips in Portuguese and other districts of East Central Africa. In this he expresses disappointment (1899, p. 337)



Map showing the general area of distribution of *Ceratotherium simum simum* in green. After Heller (1913). Redrawn on a larger scale with a few corrections and with the present names of the territories substituted. The letters indicate actual records according to Heller. Hoffman's record (1961?) has been added:

A Burchell, 1817: Northern Cape Province.
B Campbell, 1822: Kuruman (Mashow).
C Harris, 1838: Marico and Limpopo river.
D Peters, 1842: Lourenço Marques.
E de la Gorgue, 1847: Zululand.
F Cumming, 1850: Marico and Limpopo river; Kurrichane.
G Andersson, 1856: Walfish Bay; south-west of Lake Ngami.



H Livingstone, 1857: Lake Ngami.
I Baldwin, 1863: Amatongaland and Marico.
J Selous, 1881, 1893, 1894, 1899: Upper Chobe river; Mashonaland.
K Nicolls and Eglington, 1892: North-east Mashonaland; Sabi river (i.e. in Mashonaland).
L Bryden, 1893, 1897: Mashonaland and Zululand.
M Oswell, 1895: Molopo river and Mabotse Station.
N Coryndon, 1894: Mashonaland.
O Sclater, 1900: Kimberley.
P Newton, 1903: Zululand.
Q Hoffman, 1961?: Vals river in the O.F.S.

"in not meeting with the square-mouthed rhino in the Mozambique Province, as I had expected to do". In another passage in the same book (p. 133) he writes that "in no portion of that province (that is to say Mozambique—author) is the square-mouthed species found, nor is it known to natives". This statement is open to doubt. It may just have happened that his route did not take him into parts where the animal was present. Its former distribution in Portuguese East Africa does not concern us here, but it may be noted that Peters (1852) writes that although he had no opportunity to examine the animal himself, he convinced himself of its presence by obtaining a pair of horns in Lourenço Marques which were still joined by skin.

What Kirby has written about the White Rhino in Portuguese East Africa has been referred to merely to furnish further proof of the fact that he had a good knowledge of this animal. It is important, also, to note that either the whole manuscript of his book "In Haunts of Wild Game", or at any rate the subject matter of Appendix I, was submitted to so well-known a zoologist in his time as Dr. P. L. Sclater (*vide* above).

It does not necessarily follow that when Kirby saw a White Rhino cow and big calf in the "Matamiri Bush" in 1895, there must also have been other full-grown animals, especially bulls. He says that the calf was a big one, and in view of the totally uncontrolled slaughter of the wildlife of the low veld in the latter half of the nineteenth century, it is possible, and even probable, that the bull or bulls had already been killed. Kirby (1920, p. 231) states that a cow and calf without the bull are often seen together (in Zululand).

Another point made by Pienaar is that the Nwatimhiri bush is unsuitable for the Square-lipped Rhino because of the dense bush and comparative lack of grass. But in this connection Kirby (1920, p. 234) writes as follows: "It has always appeared to me that the white rhinoceros of Zululand is a more decidedly bush-loving animal than it is elsewhere; some of the streams are fringed with stretches of very dense bush, inside of which the ground is always moist and the air cool, and while it seems quite the correct thing to find buffalo congregating there, and any number of bushbuck, it appears incongruous to meet with white rhinoceroses in such places. Nevertheless these animals pass a very great deal of their time in these localities, and very often lie up for the day in them". There is no reason to suppose that the Square-lipped Rhino did not behave in the same manner formerly in the dense bush along the Nwatimhiri River in what is now the Kruger Park. Constant harassing by numerous illegal hunters could have been responsible for their seeking shelter in the dense bush during day-time and leaving it at night to look for food and water further afield. A map of game habitats in Pienaar's paper (1963, p. 16) shows that the dense thorn bush thickets around the confluence of the Nwatimhiri River with the Sabie River become "mixed Combretum Savanna Woodland" up-stream. The grazing in this habitat is described (p. 13) as being predominantly sweet and of excellent quality. He goes on to say that it is the outstanding game habitat that supports the largest ungulate community of any one area in the Park. When food was scarce in the Nwatimhiri bush, the White Rhinos that formerly occurred there had this adjacent mixed Combretum Savanna Woodland at their disposal for grazing.

Sometimes the Square-lipped Rhino is found in rocky territory. Thus Selous (1899, p. 67) noted in 1873 that he had seen many black rhinoceroses and one of the "square-mouthed" species "scrambling with great activity up and down steep stony hills". But he believes that this animal had gone astray. Kirby (1920, p. 239) writes that he never found it high up on rocky hills, on which the Black Rhino likes to clamber about, but when put to it the White

Rhino can negotiate uncommonly steep and rocky places with agility, and further that the animals travel about the foot-hills.

According to Foster (1960, p. 28) "the Square-lipped Rhinoceros is wholly a grazer under normal conditions, but in times of drought, when there is a scarcity of grass, they also feed on small shrubs and a dwarf euphorbia *Stapelia* sp. (sic.)—Zulu isihlehle—as well as on the succulent stems of a leafless creeper *Sarcostemma viminale*. On account of the sparsity of such plants within the high density area they cannot be regarded as a regular diet of the rhinos". Kirby (1920, p. 236) states that White Rhinos "undoubtedly do assimilate a certain quantity of leaves of low-growing ground plants which they take in their mouths along with the grass". He also refers to the presence of large tracts of "ihlehle" thorn in the Umfolozi Game Reserve, in which the majority of the White Rhinos in the vicinity are met with during the day sleeping inside them (1920, p. 235). In a letter dated 30th August, 1963, the Senior Warden of the Umfolozi Game Reserve, Mr. Ian Player, informs me that the plant called "isihlehle" by Foster is the common prickly pear (that is to say *Opuntia* sp.—author), and that the Square-lipped Rhino feeds on this in times of drought. He also states that Vaughan-Kirby planted prickly pear in certain parts of the Umfolozi Game Reserve in the year 1918. According to Player there is no record of the animal ever eating any kind of *Euphorbia* or *Stapelia*.

To sum up, therefore, we have the position that Selous recorded the presence of the Square-lipped Rhino in 1871 in certain parts of the Eastern and South-eastern Transvaal. He also states that it was generally believed that by 1890 the species had become extinct in every other part of South Africa (except North Mashunaland). He was, therefore, not aware of the few that remained in Zululand in that year, nor of those that must have survived in the Matamiri bush according to Kirby. In 1878 Glynn recorded its presence on the edge of the "Matamere Bush", and Kirby found a cow and big calf in the same bush in 1895. It is seldom possible to fix the exact year in which a wild animal disappeared from any particular habitat. But in the present instance there is no known reason for rejecting Kirby's statement that the animal disappeared from the "Matamiri Bush" in 1896. Perhaps a diary will be found at some future time that will shed additional light on this animal's former distribution in the low veld, or skulls may be found along the Nwatimhiri or the Sabie River or elsewhere.

Man was responsible for exterminating the Square-lipped Rhinoceros from the Transvaal Province, but after the lapse of about 65 years he was also responsible for bringing it back.

When the late Mr. P. Grobler, Minister of Lands at that time, opened the first meeting of the National Parks Board of Trustees on 16 September 1926, he drew special attention to the case of the Square-lipped Rhino and said that it would be a very good thing if this rare species were brought back to the Park (Bigalke, 1954). Some time later the late Mr. Herbert Lang proceeded to Zululand and submitted a report in May, 1928, dealing with proposals to capture some of the rhinos. It was only after modern methods of immobilizing game animals with organic drugs became available that this project was carried out. Two pairs from Zululand reached the Kruger Park on 13 October 1961, and another seven subsequently. More are being brought from the Umfolozi Game Reserve.

The Square-lipped Rhino has also been introduced into the Province outside the boundaries of the Kruger Park. Two bulls arrived at the Loskop Dam Nature Reserve and Public Resort on 2 April, 1963, and two cows on the fifth of the same month. For some time they are being kept in an enclosure about 10 morgen in extent, and later they will be let loose in the

Reserve. This group produced the first calf, a female, on 11 April 1964. This is a very important event, not only because it is the first calf of its kind born outside Zululand since the animal disappeared from the rest of South Africa, but also because it is the first one born in Transvaal since 1896.

In conclusion I would like to thank the following for the loan of literature or looking up old references or helping in other ways: Mr. R. W. Hayman of the British Museum, Dr. V. Fitzsimons, Dr. A. C. Hoffman, Dr. A. W. Crompton, Dr. F. H. Talbot, Mr. A. M. Brynard, Mr. Ian Player, Mr. C. J. Ward, and the librarians of the Africana Library, the Johannesburg Public Library and the State Library in Pretoria.

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Fruitful Scientific Work on Parasites infesting Wild Animals in the Transvaal

Dr. F. Zumpt

South African Institute for Medical Research

FOR many years the Department of Entomology of the South African Institute for Medical Research, in collaboration with the Medical Ecology Centre of the State Health Department, has directed a survey of the arthropod parasites of wild animals in Africa south of the Sahara. Many other scientists in South Africa and abroad participate in this work. The results will be summarized in four volumes, which are to be published by the South African Institute for Medical Research, with financial support from the South African Council for Scientific and Industrial Research. The first volume appeared in 1961, and deals with the mites and tongue-worms found parasitic on mammals, birds, reptiles and amphibia. There are 940 species of parasites listed, which infest 778 wild and domesticated animals. Six scientists have contributed to this book, namely Drs. J. R. Audy (San Francisco), J. Gaud (Paris), R. F. Lawrence (Pietermaritzburg), W. M. Till (London), P. H. Vercammen-Grandjean (San Francisco) and F. Zumpt (Johannesburg).

Dr. G. Theiler of the Veterinary Research Laboratories, Onderstepoort, is at present engaged in compiling the data on the ticks, and Dr. E. Haeselbarth and I are working on several groups of parasitic insects, mainly on fleas and the myiasis-producing flies.

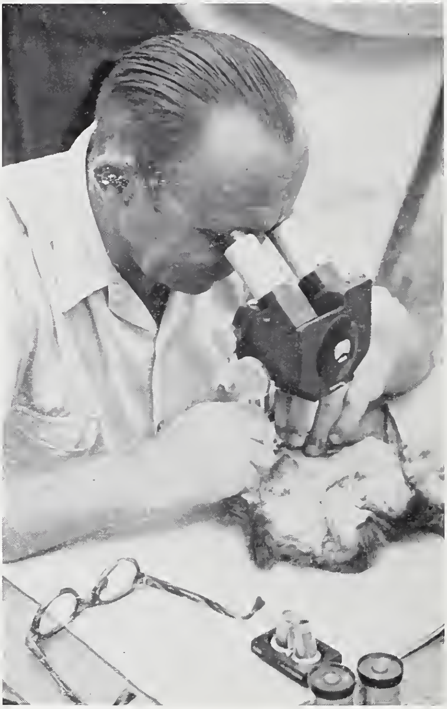
When our team started this work, only a few groups of arthropod parasites had been comprehensively studied, for instance the biting lice by the late Mr. G. A. H. Bedford at Onderstepoort. But there were other groups on which hardly any work had been done, and it was, therefore, of the utmost importance to arrange field-trips for collecting material in order to study the aetiology of parasitic diseases in wild animals and with respect to nature conservation, and to gather more data about the potential danger of game as reservoirs of diseases for man and domesticated stock. Similar field investigations were started simultaneously in other parts of Africa, mainly by English, French and Belgian workers.

The best places for carrying out such research work are Nature Reserves with their rich and relatively undisturbed animal population. I am glad to say that from the beginning the relevant authorities have offered every support, and we have been able to examine a number of wild animals which due to their rarity had hardly ever, if ever, been studied before.

One of the first authorities to give us full assistance and inestimable help in our investigations was the Director of Nature Conservation in the Transvaal, Mr. T. J. Steyn. It is a pleasure and an honour for me to write something about the interesting discoveries made during our studies in the Transvaal Nature Reserves and also on private farms, the owners of which kindly gave permission for research investigations to be carried out at Mr. Steyn's request.

In 1957 Mr. Steyn informed me that a zebra and a wildebeest in the Hans Merensky Nature Reserve had to be shot. Both animals had become a nuisance. The zebra was running around with horses and made them more and more wild, while the wildebeest was very old and in a bad state of health. To go from Johannesburg to Letsitele in the Eastern Transvaal for only two animal specimens is comparatively expensive, but the results obtained from this trip eventually proved to be of the highest value, academically as well as practically.

When we arrived in the Nature Reserve everything had been perfectly arranged by the Farm Manager, Mr. Zaayman, and early the next morning the zebra was shot and we made a thorough examination of the animal. The stomach was heavily infested with larvae of the fly-genus *Gasterophilus*. The flies themselves are rarely caught in the field. They are about 1 cm. long and look like some sort of bee, but they are true flies and therefore do not sting, and have rudimentary mouth-parts and are not able to feed. Their life-span lasts only a few days, and this is why they are so rarely found in the field.

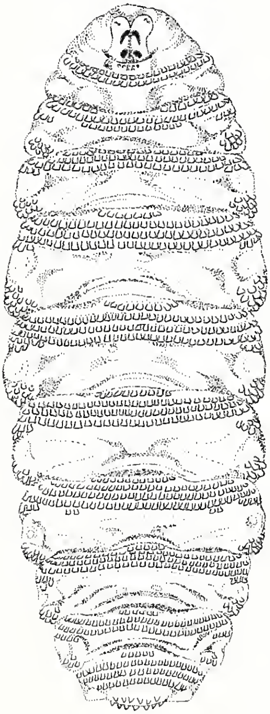


Dr. Zumpt at work in the field.

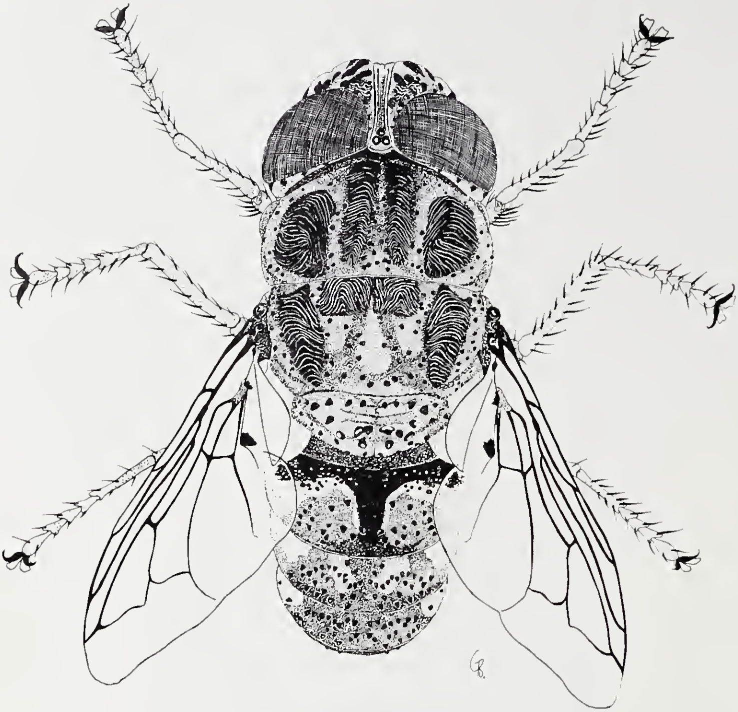
The larvae, however, are very common, and every horse, donkey or zebra is infested with them. They develop in the alimentary tract, especially in the stomach, duodenum and rectum, where they are attached to the wall by large mouth-hooks, and live on tissue exudate and occasionally also on blood. They grow very slowly and need 9 to 10 months to reach maturity. They are then excreted with the faeces and pupate in the soil.

There are seven species known from Africa south of the Sahara, and all are strictly host-specific to equids; this means that they occur only in members of this family. Those living in zebras may also infest horses and donkeys, but never cattle or sheep. The same is true for the numerous worm-parasites which zebras harbour, and a farmer who opens a dead zebra need not fear that these parasites are a danger to his ruminants.

For a detailed study of the *Gasterophilus* species it is necessary not only to study the larvae, but also to obtain the adult flies. This can be done only by rearing them from mature larvae, which is not easy. To do this, a great number of apparently mature larvae are transferred to jars containing dry sand, in which they pupate—or are expected to do so. But if the isolated larvae are not fully mature, they die, and in practice often only one or two flies hatch from one hundred isolated larvae. In our case, we were very lucky



Rhinoestrus vanzyli maggot from the nasal cavities of the Springbok.



Rhinoestrus vanzyli. Male fly.

to hatch 4 flies, and they proved to belong to a species previously known only from the larval stage. The Belgian scientist Gedoelst described the larvae as *Gasterophilus ternicinctus* in 1912 but no one had ever succeeded in rearing the fly.

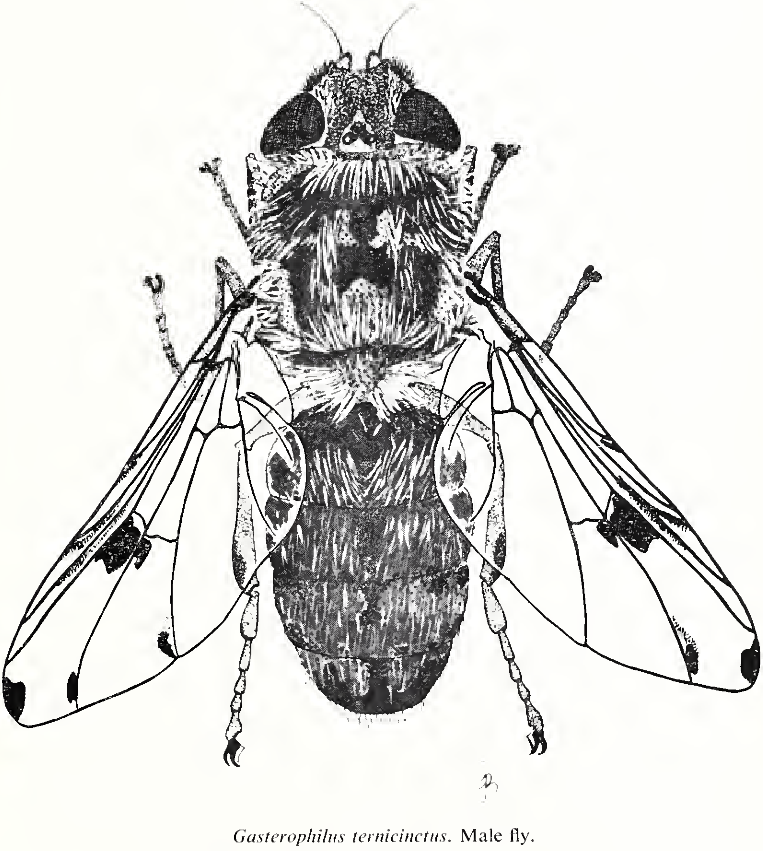
This single zebra held a further surprise. When we opened the skull, it was found to be infested with another kind of fly-maggot which belonged to the genus *Rhinoestrus*. The larvae of these flies feed on the mucous secretions of the nasal cavities, and were known at the time to occur in horses, wild pigs and the hippopotamus. The species living in the head cavities of horses had already been described in the middle of the last century as *Rhinoestrus purpureus*, and in some parts of the northern hemisphere posed a serious veterinary problem. At first we expected that our larvae would also belong to this species, especially because the zebra had for quite a while lived in close association with horses. However, the larvae looked somewhat different, and when the unexpected happened, and after 4 weeks a single fly hatched, we were able to state that a new species had been discovered. In honour of Mr. Steyn it was named *Rhinoestrus steyni*.

So far only this one specimen is known and is preserved in the entomological collection of flies of medical and veterinary importance in the

S.A.I.M.R. More larvae have been found since then, all in zebras (*Equus burchelli*), but no further flies have hatched.

To check a big animal like a zebra for parasites takes many hours, and only the next day were we able to shoot the sick old wildebeest. Lying dead on the ground it was not a pleasant sight, because large areas of the skin were affected by mange. We took pieces of the skin to the Institute in Johannesburg and treated them with special techniques and examined them. Mites were eventually detected and sent to Professor A. Fain in Antwerp, who is an expert on this difficult group. He found them to represent not only a new species, but even a new genus, and named it *Psorochorioptes zumpti*.

Bedford had already noted that wildebeest sometimes suffered from mange, but he thought he was dealing with a species of *Sarcoptes*, a genus also found in many domestic animals. Mange mites are generally very host-specific, and taking into consideration that wildebeest mange is caused by a representative of an altogether new genus, no danger exists that it may be transmissible to cattle.



Gasterophilus ternicinctus. Male fly.

Wildebeest and other antelopes also harbour fly-maggots in the nasal cavities, but they are quite different from those in zebras and pigs. More than half a dozen different species of the genera *Oestrus*, *Kirkioestrus* and *Gedoelstia* may occur simultaneously in one host specimen, and we also recovered a great number of larvae from our mange-ridden wildebeest.

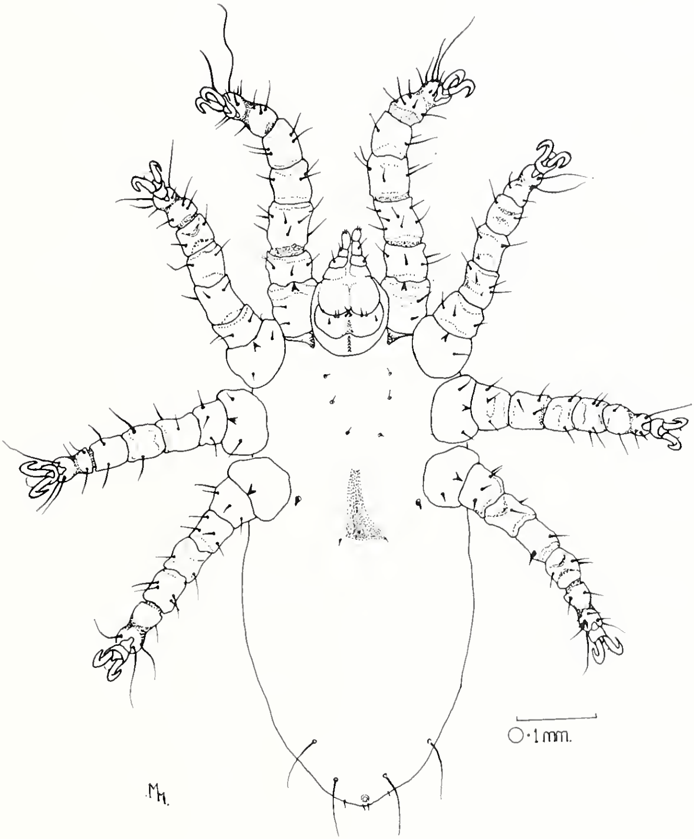
The Sheep Nasal Bot Fly (*Oestrus ovis*) in several parts of the world and also in South Africa poses an important veterinary problem, and in Mönnig's well-known text-book on "Veterinary Helminthology and Entomology" it is said that the bots of *Oestrus ovis* have also been found in the Blesbok (*Damaliscus dorcas*). This would mean that at least some kinds of antelopes form a reservoir for nasal bot flies in sheep and goats. Blesbok still occur on a number of farms in South Africa and often graze together with sheep. It was, therefore, of great economic importance when we received permission to check a number of these antelopes on the Farm "Lunsklip" near Potgietersrust. We found that the nasal cavities and frontal sinuses of the antelopes were quite heavily infected with oestrid larvae, but they belonged to species other than *Oestrus ovis*. The maggot of one of these species, namely *Oestrus macdonaldi*, is similar to *Oestrus ovis*, and may easily be misidentified by a person not trained in this work. We checked Blesbok from other localities also and a great number of related antelopes, and concluded that the Sheep Nasal Bot Fly apparently never infects antelopes, and vice versa, the oestrids of antelopes do not develop in sheep. These statements were later confirmed by veterinary people.

In January 1957, a rogue elephant had to be shot in the Pafuri district. It took us several days to find him, and many hours to perform a post-mortem. We had temperatures of 104°F and no shade, but an awful lot of smell, as can be imagined. When we opened the stomach, hundreds of maggots were floating in the semi-liquid contents. These were larvae of a curious fly called *Platycobboldia loxodontis*. It completes its entire larval development in the stomach. When the larvae have reached maturity, they crawl up the oesophagus and accumulate under the tongue in large batches. While the elephant is feeding, the maggots gain access to the open and drop to the ground, where they pupate. The flies are metallic dark blue and, like other oestrid flies, do not feed. They therefore live only a few days and are seen in the field only very exceptionally. Incidentally these and the majority of other parasites in the elephant are strictly host-specific and do not infect any other animals. This is biologically explained by the outstanding position which the elephants occupy in the animal kingdom.

Among the biological attractions of the Transvaal are the huge colonies of Cape Vultures (*Gyps coprotheres*) nesting on the steep rocks near Rustenburg. Mr. Hugh Roberts, a greatly interested farmer, keeps an eye on them, and every ornithologist in the Transvaal knows "Roberts's farm". We visit this well-known place every year, mostly in winter, when the nestlings crouch in their rough nests of sticks, with only a little bit of dry grass to give them some comfort. These nests harbour quite an interesting fauna of insects and mites. One of the first discoveries was a blood-sucking mite, which is now known to scientists as *Androlaelaps patersoni*. When such a nest is examined, thousands of these little creatures of about 1 mm. body-length are seen running about. They suck blood on the birds for only a short while, as bed-bugs do on humans, and then leave them. These mites have never been found elsewhere, neither on any other bird nor in any other locality.

However, it is a rule of nature that no one may be left in peace, not even these little mites. They are preyed on by beetles, of which we found three different species in the nests, two of which were also new to science. Furthermore, a beetle was found which feeds on the bones left by the vultures. Its name is *Trox cyrtus*, and it was also new and has been described from "Roberts's farm".

The Cape Vultures also harbour several ectoparasites, including no less than 3 different species of biting lice. By far the most puzzling parasite on the nestlings and adults are small tick larvae. They are firmly attached to the skin and belong to the genus *Argas*, which also includes the fowl-ticks. They represent a new species, which has, however, not yet been described, because we have not been able to find the adults. We have tried everything, without success. They must be there, of course, hidden in crevices and cracks, perhaps some distance from the nests, and possibly feeding on altogether different animals, such as lizards or other small vertebrates. We hope to



The mite *Zumptiella cynictis* from the nasal cavities of the Yellow Mongoose (*Cynictis penicillata*).

find them some time, but until then we shall visit "Roberts's farm" again and again.

Many other places have been visited, for instance the Sabi Sand Wildtuin, Mr. Few's farm "Swaarverdiend", and the "Coopersdal-Boere", Komatipoort, and we have never returned without having found something new or interesting. But the most successful place in the Transvaal, from the parasitological point of view, was the S.A. Lombard Nature Reserve near Bloemhof. The most unexpected results have been gained there, thanks to the willing assistance of the Chief Biologist, Mr. J. H. M. van Zyl and his staff.

In 1954, with Dr. W. Till, I published a revision of mites found in the respiratory system of mammals. Most of them belong to the genus *Pneumonyssus* and infest primates (monkeys, baboons and apes), dassies, and also the domestic dog. In the American literature we came across a *Pneumonyssus* species described from a squirrel, which belongs to the order Rodentia. Never before had a nasal mite been found in a rodent, and the drawing given by the author revealed so many strange features that we did not include it in the genus *Pneumonyssus*, but suggested that it belonged to a new, still undescribed genus.

A few years later, we recovered mites from the nasal cavities of the springhare (*Pedetes capensis*) shot in the Lombard Nature Reserve and also in the Kalahari. They belonged to the same genus as the American species. Professor A. Fain, the famous Belgian parasitologist, created for them the genus *Zumptiella*, and called the springhare parasite *Z. furmani*, in honour of the American author who discovered the first representative of this genus. Only a few months later a third *Zumptiella* species was discovered in the nasal cavities of the Yellow Mongoose (*Cynictis penicillata*), which is very common in the Lombard Nature Reserve and lives in close association with the Ground-Squirrel (*Xerus inauris*). Mongooses are carnivores, and squirrels are rodents. When we found the first mites in the mongoose, we thought we were dealing with an accidental infection, and that the true host of the new *Zumptiella* species would be the squirrel. This was to be expected from a hypothetical point of view. But in biology one must be very careful with theories. We then started to examine a number of mongooses and squirrels (they are a pest there) and found the mongooses always infected, and never the squirrels, in spite of the fact that the two animals live in the same burrows. The new mite, *Zumptiella cynictis*, is, therefore, strictly host-specific.

For a long time we had been puzzled by maggots occasionally recovered from the nasal cavities of springbokke (*Antidorcas marsupialis*). Only a few specimens had come to our knowledge belonging to two different species of the genus *Rhinoestrus*, which was then known only from equids, pigs and the hippopotamus. These latter hosts are Perissodactyla and lower Artiodactyla, but antelopes are higher Artiodactyla, and had always been found to harbour species of the genera *Oestrus*, *Kirkioestrus* and *Gedoelstia*, but never those of *Rhinoestrus*. But again, one must be careful with theories in biology. One day Mr. van Zyl informed me that he too had found fly maggots in the nasal cavities of springbokke, which are still to be found by the hundred in the Lombard Nature Reserve. Once again we went there and examined a greater number of these antelopes. About 80 per cent were found to be infested with nasal maggots, and the two new species found were described as *Rhinoestrus vanzyli* and *Rhinoestrus antidorcitis*. We reared several dozen adults successfully never before seen by any scientist.

Our work continues. More new species and more interesting as well as economically important facts will come to light. Africa is still an unexplored continent in many scientific fields.

We as scientists find much pleasure in our work owing to the generous assistance received from the South African authorities. These investigations are helping South Africa to hold its own in the world-wide field of research.

*THE GEOLOGY OF BARBERSPAN AND ENVIRONS

Dr. J. W. von Backström

Assistant Director, Geological Survey

1. INTRODUCTION

Barberspan lies approximately 3 miles north of the Harts River and 50 miles southeast of Lichtenburg, at the intersection of 26° 35′ south latitude and 25° 35′ east longitude.

As the area is one of low relief the pan can be easily approached from all sides and both the railway-line and tarred road between Delareyville and Sannieshof by-pass it at a mile distance.

Mapping was done with the aid of aerial photographs to a scale of 1 : 30,000. The geological data were transferred by pantograph on to a base-map prepared to a scale of 1 : 25,000 by the Trigonometrical Survey Division. The contours were derived from plans of the pan kindly supplied by the Department of Water Affairs.

The writer is indebted to Dr. T. Farkas of the Division of Nature Conservation, Transvaal Provincial Administration, for his kindness and hospitality.

Polished and banded amygdules recovered from the lava, Barberspan.

2. PHYSIOGRAPHY

A. Relief

The area lies between 4,400 and 4,481 feet above mean sea level and forms part of the High Veld of southwestern Transvaal. It is characterized by the absence of any marked physiographic features, and, in general, may be described as a great, undulating plain, diversified with rises and hollows which differ little from one another and from the general plain in height.

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* Published in terms of the Government Printer's Authority No. 3171 of 11.6.63.

Pans have developed on all the geological formations on the High Veld and are especially numerous in the Barberspan area, the largest perennial freshwater pan in the Republic of South Africa. Except for the larger ones, which are irregular in form, pans are round or oval and vary from a few yards to more than 3 miles in diameter.

B. Drainage

The gradient of the Harts River and its tributaries draining the flat undulating plain around Barberspan is low. A survey showed that flood water has always flowed from the Harts into Barberspan, which lies at a lower elevation. About 50 years ago a low earth wall, hardly still recognizable as such, was thrown across the Harts and a shallow excavation was made at the same time, through an obstruction of surface limestone, in order to increase the flow of water towards the pan. Over the years a well-defined channel, 30 feet wide and from 3 to 5 feet deep, with a capacity of at least 500 cusecs has been excavated by the water between the Harts and Barberspan.

At present Barberspan receives and can take all the water coming down the Harts and it is only at times of peak flood, when the river overflows its banks, that some of the water by-passes the bifurcation and flows down to Schweizer-Reneke. Water from Barberspan has never pushed over the limestone neck (lowest elevation 4445·2 feet above sea-level) into Leeupan, although it came very close to it in January 1944.

In sharp contrast to the above, the pan was dry during the great drought of the depression (1933–34) and a serious health hazard was created by the fish mortality. In spite of the oft repeated story that the pan derives an appreciable amount of its water from strong springs along its bottom, no signs of them were found at the time.

Barberspan is located 3 miles north of the Harts River along a fossil drainage channel. It can be traced for a further 28 miles northwards and is considered to be an old tributary of the Harts. [See published Geological Survey Sheets 54 (Lichtenburg) and 60 (Ottosdal)]. For the first 18 miles the channel is fairly well-defined and marked by 10 reasonably large pans of which Leeupan, Deelpan and Manunispan are the most prominent. Over the last 10 miles the trace of the old channel disappears completely and 8 smaller pans lie along its former course.

The bottom of Barberspan (at 4,394 to 4,396 feet above sea level) is 30 to 32 feet lower than the point of intake of the channel from the Harts (at 4,426 feet above sea level) feeding Barberspan. In spite of this there are good reasons to believe that the pan was formed due to impeded drainage of an old tributary of the Harts and that the wind played an important part. Strong and persistent winds from the north prevail throughout the autumn and early summer months, carrying fine limestone from the floors of the great pans, which, with the exception of Barberspan are dry, except after good rains. Since times immemorial, this material has been deposited against the southern flanks of the channel, where it gradually built up the low koppies that impeded the drainage and caused the formation of the pans. The koppies south of Barberspan and Leeupan reach heights of 80 feet and 76 feet respectively above the floors of the pans and here, as elsewhere, their size and height are roughly in proportion to the extent of the pans themselves (plate 1).

1. Flat, rounded hillock of pan-limestone between Barberspan and Leeupan that impedes the natural drainage.

Barberspan has a catchment of 15 square miles and a run-off of only 75 morgen feet per year. It has no natural outlet and apart from 200 morgen feet of water per year used locally (at a maximum), all further loss of water from the pan must be attributed to evaporation. The nett average annual evaporation—taken at 48 inches—amounts to 6,000 morgen feet, which means that Barberspan will easily retain water for 2 years without drying up completely.

The capacity of the pan at different depths of water is given in table 1.

TABLE 1

Capacity and extent of Barberspan at different water surface elevations

Elevation of water surface above sea level in feet	Capacity in morgen feet	Surface area of water in morgen	Average evaporation in morgen feet yearly
4,400	3,730	813	3,252
4,405	8,179	965	3,860
4,410	13,605	1,255	5,020
4,415	20,640	1,564	6,256
4,420	29,180	1,800	7,200

The pan is fairly full when the water reaches 4,415 feet above sea-level and at 4,420 feet it laps the base of the railway bridge.

An average of 4,920 morgen feet of water per year reaches Barberspan (measured over 10 years) from the Harts River and this corresponds closely to the total evaporation when the water in the pan stands at 4,410 feet above sea level (table 1).

C. Quality of the Water

Two chemical analyses of water from Barberspan, done by the Soils Research Institute, are given in table 2.

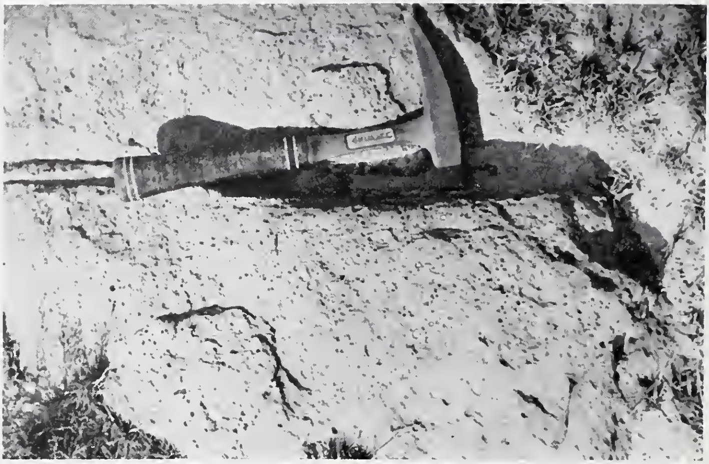
The millinormalities (milligram/litre subdivided by the equivalent weight for both cations and anions) have been calculated. The amount of each constituent present is expressed as a percentage of the total dissolved solids at 105°C—except HCO_3' which is unstable at this temperature.

Table 2

Chemical analyses of water from Barberspan

	Date			
	4 March 1960		1 December 1960	
Capacity in morgen feet when sample was taken	15,775		14,900	
pH at 20°C	9·1		8·7	
Dionic conductivity at 20°C	1,600		1,800	
Total dissolved solids at 105°C (mg/litre)	1,032		1,161	
Ions	Mg/litre	$\frac{N}{1000}$	Mg/litre	$\frac{N}{1000}$
Na'	346	15·04	409	17·80
Ca''	12	0·60	14	0·70
Mg''	32	2·63	35	2·90
Sum of cations	390	18·27	458	21·40
F'	0·6	0·03	0·6	0·03
Cl'	305·0	8·60	351·0	9·90
NO_3'	nil	—	nil	—
SO_4''	nil	—	nil	—
CO_3''	84·0	2·80	90·0	3·00
HCO_3'	418·0	6·85	519·0	8·51
Sum of anions	807·6	18·28	960·6	21·44
Permanent hardness as $CaCO_3$	nil		nil	
Temporary hardness as $CaCO_3$	160		180	
$NaHCO_3$	307		412	
Na_2CO_3	148		159	
Percentage of total dissolved solids	Per cent		Per cent	
Na'	33·5		35·2	
Ca'	1·2		1·2	
Mg''	3·1		3·0	
F'	0·06		0·06	
Cl'	29·6		30·2	
NO_3'	—		—	
SO_4''	—		—	
CO_3''	8·2		7·8	
Permanent hardness as $CaCO_3$	—		—	
Temporary hardness as $CaCO_3$	15·5		15·5	

Analysts: P. T. Viljoen and N. A. van der Walt. Soils Research Institute, Pretoria.



2. Amygdaloidal andesitic lava with vesicles and amygdules of chalcedony.

The analyses show that the water contains reasonably high concentrations of salts. Although the water is fairly suitable for human and faunal consumption and can be used for irrigation, it has a very brack taste. Ordinary table salt (sodium chloride) forms more than half of the total dissolved solids and, together with the relatively high sodium and calcium carbonates present, account for its pronounced brackish taste and relatively poor quality.

Since the pan has no natural outlet and the figure for evaporation is high, it can be expected that the salt content (i.e. the total dissolved solids) will build up in the course of time even though it may be a slow process.

3. GEOLOGICAL DESCRIPTION

The latest age determinations on rocks as well as astronomical data indicate that the earth has existed for at least 4.000 million years as a planet of the sun and covers approximately 200 million square miles. The geology of the 15 square miles around Barberspan is as follows.

The greater part of the Western Transvaal, including that of the pan, is underlain by amygdaloidal lava of the Ventersdorp System. According to Nicolaysen (1962) these rocks must be at least 2,100 million years old. At this time lava was emitted in a molten condition by way of large fissures from the depths of the earth and flowed out on the surface. Upon emission the lava is usually charged, in variable degree, with steam and other gases, which give rise to vesicular rock-types.

The unweathered lava is usually blue to greyish-green in colour, but is mostly reddish-brown on the surface. Rarely, if ever, is it possible to distinguish individual minerals by visual examination. The lava is andesitic and strongly amygdaloidal.

Vesicles are filled by one or more of the following minerals which form amygdules: colourless quartz, white, red or blue chalcedony, agate, red jasper, calcite, chlorite and epidote. They vary locally in size, composition and number (plate 2).

3. Cover of soil on surface limestone forming a hard crust near the surface with softer and nodular material deeper down.

Certain types of amygdules are strongly resistant to weathering and have been transported to the pan by water where they are found widely scattered on both the lava and the surface limestone. In places (especially northwest of the pan) they have been cemented by the lime to form an agate-conglomerate.

Many of the amygdules have a concentric structure, owing to two or more minerals being arranged in alternate bands within them. Locally amygdules up to 6 inches in diameter were found, many of which take a fine polish.

Primitive implements made of lava are widely distributed on all the geological formations around the pan. A number of these were submitted to Dr. R. Mason, Archaeological Department, University of the Witwatersrand, who classified them as follows:

(*a*) 11 Flakes (used as knives). Earlier Stone Age, more than 50,000 years old.

(*b*) 16 Flakes (similar use). Middle Stone Age, between 10,000 and 40,000 years old.

(*c*) 1 Flake, possibly Later Stone Age, less than 1,000 years old.

More than 2,000 million years after the eruption of the Ventersdorp lava, in relatively recent geological times, surface limestone started to form and practically surrounds Barberspan and Leeupan (see folder). Its lateral extent and thickness could not be determined, owing to the general cover of soil and alluvium (plate 3).

The surface limestone varies from types of a fairly high purity to types that may be described as calcrete and which are well-developed northwest of Barberspan on Vergenoeg 303 IO. At the surface the limestone is usually hard and massive; below the hard crust it is softer, granular and friable, and slightly stratified.

4. Vlei-limestone containing nodules, uneven lenses, plant-roots and soil and clay.

Depending on its method of origin, the surface limestone has been subdivided into vlei-limestone and pan-limestone, although this classification could not be consistently adhered to and they are therefore not always shown separately on the geological map. The vlei-limestone is limited to the lower lying areas and the pan-limestone to the koppies.

The vlei-limestone usually consists of a mixture of fine white or light grey chalky material containing varying amounts of crumbly, porous nodules. Lenses of hard, crystalline to cryptocrystalline limestone occur irregularly within it, while plant-roots, partly or wholly replaced by limestone, are fairly abundant locally. Clay, soil, and fresh-water shells are locally present in varying quantities (plate 4).

As described previously, the wind played an important part in the formation of pan-limestone. These deposits are characteristically even-grained, as lumps, nodules, fragments, and large grains of limestone are lacking. Chemically and mineralogically the limestone is impure on account of the presence of fine dust and other material deposited at the same time (table 3).

TABLE 3

Spectrographic analysis of vlei-limestone

	Percentage	
SiO_2	9·8	Sample taken from quarry south of Barberspan on Groenfontein 311 IO.
Al_2O_3	5·9	
Fe_2O_3	3·6	
MgO	6·4	
CaO*	42·3	
MnO	nil	
$CaCO_3$* . . .	75·5	

* Calculated values.

Spectrographic analysis by H. D. Russell. Geological Survey, Pretoria.

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SOUND AS A MEANS OF COMMUNICATION BETWEEN BIRDS

Dr. T. Farkas

BIRDS that are met with in far distant deserts or in the most silent depths of primeval forests, and that seem to be among the most lonely of their kind, are by no means as lonely as we are led to believe on first acquaintance. On closer examination of such a bird's activities, it will soon become evident that there are many animals with which it must come into contact daily in one way or another to ensure its existence or its safety. Apart from numerous enemies, there are also the members of its own race that affect the individual's daily life according to whether it belongs to a social or perhaps a solitary species. These mutual contacts between individuals of the same and of different species have always necessitated a complex system of communication between birds. At present this system is considered to be one of the most highly developed in the whole animal kingdom. From a practical point of view it is nothing but the whole pattern of their behaviour, the effect of their beautiful colours and their voices. The sense of smell, that may play an important part in mammals, is of little consequence in birds.

Of the various factors of the communication system, I shall confine myself to that of sound, for, as we shall see later, this system of communication is so highly developed in birds that it is only surpassed by that of man. This does not, of course, apply to every kind of bird, but particularly to that group which is known in *systematics as song-birds (*Oscines*).

The most important anatomical difference between song-birds and all other birds is that in the former the lowest part of the wind-pipe, the syrinx, which is responsible for the production of sound, is a very complicated organ. It is formed by the last cartilaginous rings of the wind-pipe and the few upper rings of the bronchi (branches of the wind-pipe leading to the right and left lung). Between these rings there is a membrane that is stretched tightly and that can be tightened or relaxed through the action of at most seven pairs of special small muscles. When air is expelled from the lungs, it must pass over this organ and higher or deeper tones result from the position in which the membrane is held by the muscles, and we hear these as the song or notes of the bird. In birds the frequency of the sound waves varies between 20 and 16,000 per second but may rise to 50,000 in certain cases, and this is far above the capacity of the human ear (*supersonic sound*).

As already mentioned, the syrinx attains its highest development in song-birds. In general they are able to produce the most perfect tone variations. In all other birds, which may be grouped together as non-singers, the syrinx is of a rather simple construction. Hence they are capable of only a rather simple sound production. There are quite a number of exceptions to these two rules, but this does not affect their general applicability. In ducks, for example, the syrinx is of a peculiar and complicated form, but nevertheless these birds are not considered to be good songsters. There are

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* The science that classifies animals in related groups according to their characters, body structure and other features.

The Cape Longclaw (*Marcronyx capensis.*)

also song-birds which, in spite of their highly specialized syrinx, are not looked upon as being enchanting singers. Such are some of the warblers.

Mention may at this juncture be made of an old superstition, according to which certain kinds of birds are able to learn the articulate speech of man more easily if their tongues are split. But, as we have already seen, it is the syrinx of birds that is responsible for the production and modulation of sound. This is proved, *inter alia*, by the fact that if the throat of ducks or fowls is cut off, the birds are still able to produce sounds for long after. In birds the tongue plays no part in the production and modulation of sound. For this reason slitting the tongue is nothing but needless torture of the animals. In connection with the part that the tongue may play in modulation, there is perhaps one exception which has not yet, however, been proved beyond all doubt. Since the tongue of parrots is provided with many muscles, some authorities are of the opinion that in these birds the highly developed tongue may participate in the production of sound. But as parrots have a natural aptitude for speech, it is senseless to torture them with an unnecessary operation.

After this short introduction, the question may be asked: "How is the voice of birds used as a means of communication?" Is it perhaps a kind of language that we can learn or at least understand? To this question a definite "yes" is in part possible. In the Bible we read that Solomon, King of Israel, could understand the language of animals and tradition added that the King had a magic ring that gave him this power. If we ignore this legend, there remains the King's wisdom, and this can be explained by modern scientific thought. I am of the opinion that the most important factor in this matter was the King's realization that if we wish to understand the "language" of animals, we must try to detach ourselves from the human attitude of mind and interests and try to put ourselves in the animal's place. In other words, those who expect the animals to relate long stories or perhaps tell us something about hidden treasures will wait in vain for such a wonder. Animals have no interest whatsoever in such human interests as abstract values, mathematics or similar things, but certainly in matters affecting their lives. Hence in practice we must first rid ourselves of our egoistic interests and consider the bird's requirements. We shall then be surprised to see how soon we get an insight into the bird's language.

A bird's world—like that of other animals—consists mainly of its relations to its fellow members, to other birds and enemies, to prey or to neutral species that may play a part in its life, and also of its relations to the area in which it lives with its climate, its type and its vegetation. To the various influences to which it is constantly exposed in its environment, the bird reacts by means of its behaviour. It gives vent to its reactions by means of its voice. For us this means that knowledge of its behaviour is closely linked with its voice, or in other words to be able to understand the meaning of any sound, we must also recognize the dominant emotions and behaviour of the bird at that particular moment. We shall confine ourselves to a discussion of voice sounds.

It has already been mentioned that the most important environmental factor by which a bird is influenced is the members of its own race either in the form of a competitor, or a companion or a descendant. For each of these the individual uses a certain number of sounds to express its own desires and emotions or to convey them to others. A simple example is that of the cock who avails himself of crowing (*a*) to let other cocks know that he is alert and ready to fight, and (*b*) to remind his hens of his presence, his authority and his protection. If a cock has found a special titbit, he emits another sound to which the hens react by running to him to ensure that they get it. If a quarrel has arisen between the hens, a series of different sounds are emitted by them. The hen that is ready to lay an egg or has already done so emits other sounds. When she leads her chickens about, or warns them of danger, or has found food for them, she makes use of certain sounds. This is nothing new to the poultry farmer. If we confine ourselves to the simple case of the domestic fowl, we shall be able to recognize at least 20 to 25 different sounds, which everyone with a little practice will be able to understand as well as his own language. Here we have confined ourselves to a single factor in the life of a fowl, namely the sounds that it emits in relation to the members of its own race. If we include the sounds associated with other factors (relations to other animals, changes in the weather) or with emotions (fear, unrest, satisfaction, hunger, satiety, death etc.), the number of sounds will easily be doubled.

As indicated in the introduction in connection with sound production by means of the syrinx, birds can be divided into two groups, the non-singers and the true song-birds. The fowl, which was taken as a simple example, belongs to the first group. In the song-birds, which possess a much more efficient syrinx, there is a greater capacity of sound modulation. Associated with this there is generally also a larger number of sounds that are emitted. But as the mode of life of song-birds is not yet well known, there are relatively few song-birds about which we have reliable information. It is only in post-war years that important progress has been made in this line of research by means of improved types of tape-recorders. The magnetic tape can record the most delicate sounds and the slightest modulations accurately and make them available for analysis. As the result of observations that have already been made, we find that in the better known song-birds the number of different sounds may be remarkably high. Nor is this all. Song-birds are, of course, able to sing, and these sounds also play a part in their mutual relations as a means of communication. This raises their "language" to a higher plane than that of the non-singers.

In its origin the singing of birds seems to be but a more or less complicated system of sounds. This is confirmed by the development of song that takes place as young birds grow up to sexual maturity. Young song-birds but a few weeks old already have a fair repertoire of sounds, by means of which they convey their requirements and emotions to their parents. After a short while young birds begin to join the sounds together—particularly in the case of calls—and thus we get the first primitive song of the individual known as the subsong. During subsequent months this subsong is enriched as the bird's ability to modulate increases. Gradually it is superseded by the rehearsed song, which is fully developed about the end of the first year. The subsong now disappears completely. But the rehearsed song is permanent and is especially characteristic of the sexually mature individual when it is not breeding. Opinions differ about the significance of the rehearsed song. Here I shall mention only the most important, namely that it serves to maintain contact between the individuals of different ages and different sexes of the species concerned.

Associated with the first moult of the young birds—generally during the third month—there is the development of the third and undoubtedly the most important type of song, the primary song. This plays a special part when the birds split up into pairs and during their breeding activities. The clear and most melodious themes of short series of notes, the separate components of which are always the same, are then run together to form shorter or longer melodies. A human being's judgment of a bird's achievements as a songster is based on its repertoire and melodiousness. The primary song of birds began to draw attention long ago, and hence our knowledge of it is much greater than in the case of the subsong and the rehearsed song. Mention must be made of the fact that the first production of the sex hormones appears to be responsible for the development of the primary song in young birds. It has been shown experimentally that when birds a few weeks old are injected with these hormones, they immediately begin practising the primary song. And in sexually mature individuals the production of hormones in the breeding-season is responsible for the primary song. It lasts until breeding is over, when the production of sex hormones is arrested by that of other hormones.

The primary song has various uses. When breeding starts, it serves to notify neighbouring members of the same race that possession has been taken of the breeding-place (territory), and it is maintained throughout the breeding-season. In certain species a special form of the primary song is associated with a display flight, when the clear song together with unusual turns in the air and the bird's bright colours also impress human beings. All are acquainted with the case of the Long-tailed Widow-bird (*Diatropura progne*). The song also assumes a special form in competing males. Whenever they vie with one another for a breeding-place or a hen, their song sounds very flurried and agitated. In such cases special melodies are often used and frequently also a very rapid and clear rehearsed song is made use of. The primary song is also intended for the hens, and there are special melodies when the cocks display and typical melodies with various emotional elements while the hens are already breeding. When the young have hatched, they are warned by the cock's primary song when danger threatens or their attention is attracted by it when the parents bring food. When the young have left the nest, the primary song has an additional function. As long as they hear it they play and career around without restraint, but when it ceases and the parents perhaps also emit warning sounds, the youngsters immediately make for cover. It is at this time that the young unwittingly become acquainted with the primary song of the parents. The separate notes are evidently not learned; numerous experiments have shown that they are innate. The principal investigators have assigned special names to all the uses and the special forms of the primary song connected with them, but we cannot deal with these here. Such fine distinctions are not necessary to convince the reader that a wide field of the most important requirements of birds is covered by this summary of sounds and bird-songs. If anyone should try to study the life-history of any kind of bird and the sounds it produces on the basis of what has already been said, he will be suprised at the rapidity with which he will gain an insight into the bird's "language".

The answer to the question put above is, therefore, that the birds do not want to convey anything to us, but are especially interested in establishing contact with their own kind. But as we have succeeded in gaining an insight into their language, they tell or reveal things to us indirectly. Here we have the key to the higher aspects of sound as a means of communication between animal and man. To put it symbolically, our demand that animals should "tell" us something is partly satisfied, that is to say knowledge of what animals convey to one another is the key that may be used by those who wish to do so to enable them to make mutual contact with a bird among other things by means of sound.

Certain natural forms of purposeful contact between bird and man have been known for a long time. Such is the case of the Honey-guide (*Indicator indicator*), which helps the natives in East Africa and elsewhere to locate beehives by means of the special agitated sounds that it makes. If this behaviour is considered objectively, it is by no means a case of benevolence

Fiscal Shrike (*Lanius collaris*).

towards mankind, for when the beehive has been plundered, the bird gets its share of the booty in the form of the fat bee larvae that are a delicacy for it. It is doubtful whether the bird's behaviour is as purposeful as one would like to believe, that is to say it is doubtful whether the bird really makes intentional contact with a human being with a view to participating in the meal later, or whether it becomes very agitated on seeing bees and then gives vent to the special sounds with which man became aquainted in past ages, and of which he made purposeful use. We also have the case of our Karroo Scrub Robin (*Erythropygia coryphaeus*), which is supposed to "warn human beings" of the presence of snakes by means of the agitated noise that it makes. Whether it is actually true or merely a figment of the imagination that the birds want to avail themselves of man's help when a beehive or a puff adder is found is a problem that will not be discussed here. For the purpose of explaining the meaning of the idea "mutual contact", I have made use of these two cases from nature. It must be added that these cases are merely two of the simplest imaginable forms of mutual contact between man and bird, and that both are concerned with a single sound. It would appear to be the case that under normal conditions mutual contact between man and birds is confined to such very primitive and rare cases. The first, and during a period of thousands of years certainly the only advance in this sphere is the domestication of certain kinds of birds, but that topic is beyond the scope of this article. But what I still want to discuss is mutual contact of a complex type, the significance and nature of which far exceed that of the simple cases of the Honey-guide and the Karroo Scrub Robin dealt with above.

In order to find a basis for mutual contact between ourselves and birds, the first desideratum is to understand their "language". In the case of many birds this initial step has already been taken, as I have summarized in the first half of this article, and this is the key to the following steps which aim at the most perfect contact with birds. Equipped with a knowledge of their "language", the investigator must strive to achieve a more intimate interest in the kind of bird concerned, or to put it in another way, he must try to play the same part in its life as that of the bird's fellows. In the accounts of early travellers, we read that when human beings first visited some of the islands in the Pacific Ocean, they found that the birds were very tame. Even at the present time the penguins in certain parts of the Antarctic have no fear of human beings. But such paradisical conditions were very rare and will become even rarer in future. In the remaining parts of the world birds, like other animals, have quickly learned to fear man, and this is the most important obstacle to establishing mutual contact between man and bird. For this reason the research worker tries to carry out his experiments as far as possible with birds that he has reared himself, when he attempts to study sound as an important factor of mutual conduct. In such cases a human being can easily acquire the status of a fellow member of the kind of bird concerned, and while enjoying the advantages of this association can make use of them in his experiments. During this very important process, which may make heavy demands on his patience, the research worker is not only obliged to understand the "language" of his freely chosen companion reasonably well, but to adapt himself to a large extent to the interests and "attitude of mind" of the bird. K. Lorenz, who is looked upon as the founder of this new branch of animal psychology, gives an amusing account of the remarks made by the inhabitants of the German village, whenever he walked through the garden with a brood of young wild ducks and continually imitated the mother duck's call in order to keep the youngsters together. But the trouble taken by the research worker is of great value, because it is by means of this complete adaptation to the bird that he is able to obtain the same status as that of a fellow member of the same species. In this manner he comes into closer contact with the bird's mind than was previously possible.

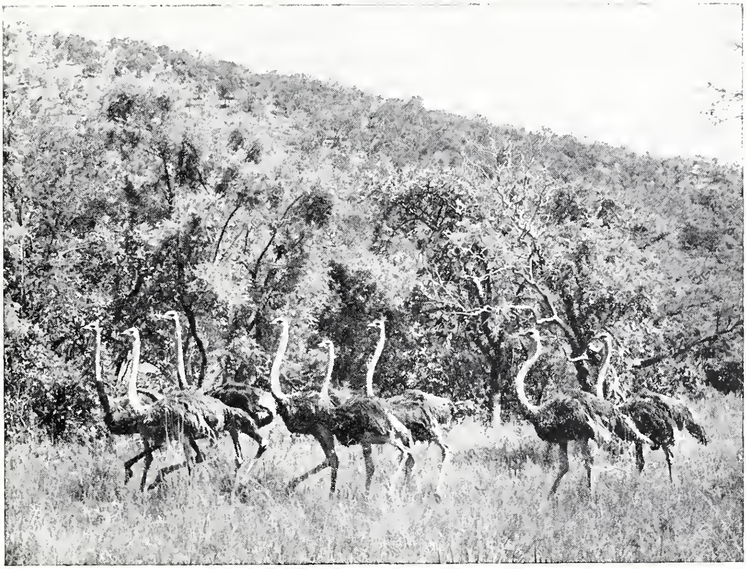
In conclusion, I would like to discuss various aspects of this kind of research and emphasize the part played by sound as a means of communication of a higher order on the basis of a case from my own experience.

About three years ago I obtained a young Cape Longclaw (*Macronyx capensis*) by chance. The bird probably fell out of its nest during a thunderstorm and became separated from its parents. As it was not my intention at that time to do research on this species, I reared the bird because I pitied it and then set it free in the garden. At this time he—or she, as transpired later—was about three months old and able to fend for himself. That she would not readily disappear was to be expected, for when young birds are reared by hand they look upon the human being as the true parent. In spite of this I hoped that if I paid no attention to her and tried to sever the association in every possible manner, she would sooner or later try to join her fellows who were plentiful in the veld just beyond the garden gate. But she had other ideas and during the last three years preferred to stay in my garden and look upon me as her "mate". The most important aspects of this extraordinary friendship will be briefly sketched.

Although this longclaw is tame, she will not always allow me to catch her in the hand. This is only allowed at certain times when it seems to suit her. Her consent is conveyed by means of a special sound. During summer she builds three or four nests in the lawn near my house. I become aware of her intention when she flies towards me with nesting material in the mouth giving vent to a particular sound and then flying in the direction of the nest. Throughout the breeding-season she engages in fierce combats with Fiscal Shrikes (*Lanius collaris*). As soon as this nest plunderer appears in the neighbourhood, she boldly attacks the shrike while emitting a call that closely resembles that of the shrike and that appears to arouse her pugnacity, and chases him around the garden until he departs. But if a pair of Fiscal Shrikes appears, it often happens that she first flies towards me while frequently emitting the shrike call in the direction of the shrikes where they are sitting in a bush. If I accept the invitation and walk towards the shrikes, she flies ahead of me while challenging them with the greatly accentuated shrike call and attacks both of them without hesitation. The combined action of the longclaw and the human being forces the shrikes to flee. This collaboration between the two of us has now become so much a matter of course with me that I immediately walk out in the direction in which I hear the shrike call given by her, whereupon she flies straight towards the shrikes and attacks them.

Last summer she established another contact between us which is not so easily explained by means of the mechanistic theory of instinct of the behaviourists. As I walked out of the house one morning, she flew towards me, and, while constantly uttering her call, she came so near to me that her wings almost touched my hair. Then she flew just above the gate into the veld. I ran after her, and just beyond the road about one hundred yards in the veld I found some Bantus breaking open a termite mound. When I reached the spot, my longclaw was already busy greedily devouring the termites. It was perfectly clear to me that her behaviour, coupled with her call, was a direct invitation to me to participate in this palatable meal, especially since this behaviour has since been observed on several occasions.

If the reader has carefully followed the example of the longclaw, he must surely have come to the conclusion that in these instances of mutual contact between human being and animal it is not the human being that consciously tries to maintain the contact, but that the bird may itself take the lead, even though this seems to be rather unusual. The research worker has taken the experiment as far as the methods of experimental science enable him to go. To try and find out what there may be beyond this will depend not only on the intellectual and psychological ability of the experimental scientist, but just as much on the individual capabilities of the bird concerned.



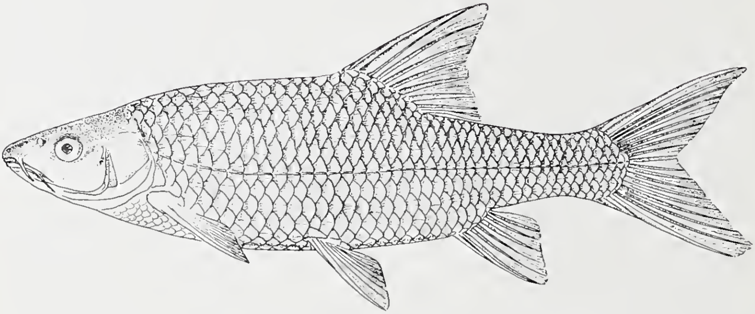
Young ostriches in the Loskop Dam Nature Reserve.

Photo: Chris Pisart.

Notes on the Growth and Longevity of the Vaal River Yellow Fish

(Barbus holubi)

P. le Roux



L. Steyn.

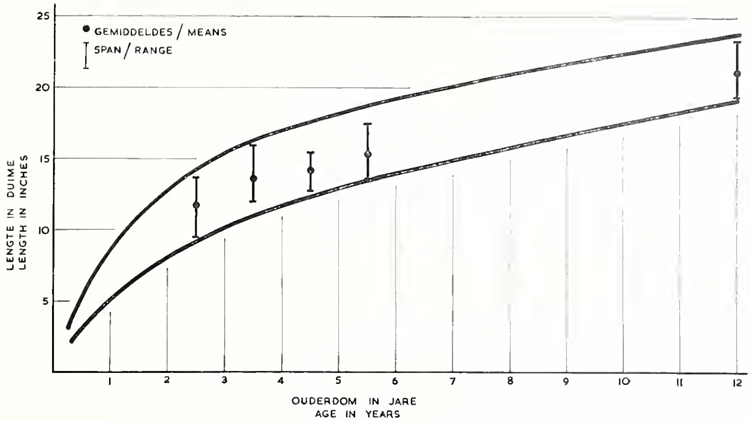
Vaal River Yellow Fish (*Barbus holubi*).

AMONG the early fish distributions from the newly-established hatchery at Lydenburg in 1951, were a number of fingerlings of the Vaal River Yellow Fish. These were introduced into various farm ponds on the High Veld.

From 1953 to 1956 several of these ponds were examined from time to time to establish how these fish were doing. Several interesting facts came to light almost immediately. In the first place it was found that these fish grew relatively slowly with an average total length of 11·7 inches after two and a half years. Secondly, it seemed as if a very small natural mortality occurred although this could not definitely be established as the ponds could not be emptied. It was also established that the fish did not spawn, or spawned unsuccessfully, in these ponds.

An experimental stocking of the Calitzdorp Dam (Cape Province) with 200 fingerlings was done in 1953. At an age of 6 years a sample of 8 fish from the dam (samples by gill-net) had an average length of 20·3 inches and weights ranging from 4¾ lb. to 5 lb. 14 oz. (Harrison, 1959). In this case there was also no concrete evidence of successful spawning, although the data indicate a faster growth-rate in large impoundments than in farm ponds.

These facts, coupled with the knowledge that very large fish are often caught in the Vaal River, led one to assume that they must be capable of reaching quite a respectable age. This was partly confirmed by a chance examination some 10 years later of one of the ponds originally examined but later omitted from the programme because of its large size (8 acres) when full, making it impossible to sample a population of 50 fish successfully.



Growth of *Barbus holubi* in farm ponds.

During the continual droughts of 1962/63, however, the pond was reduced to a relatively small puddle. A biologist examining farm ponds for experiments with the Black Bass/Tilapia combination on the High Veld had occasion to visit and net the pond. Owing to the usual crowd of helpers, onlookers and bystanders on such an occasion, some fish were inadvertently returned to the water before being examined, but a total of 37 fish were counted of which a sample of 24 ranged in size from 19·4 to 23·4 inches and in weight from 4 to 8 pounds.

These fish were almost certainly the remains of the original stocking of 50 fish now aged 12+ years. In the accompanying graph all the available data on the growth (as defined by total length) of the Vaal River Yellow Fish in farm ponds, ranging widely in fertility, are presented. The calculated means of annual samples and the observed ranges have been indicated and are at present being used as a guide in a more thorough study of the age and growth of *B. holubi* under natural conditions.

If these fish were indeed the survivors of the original stocking, and no evidence to the contrary was found at all, it gives the remarkable survival figure of at least 74 per cent over a period of more than twelve years. No progeny was found in the pond, but in recent work at the Provincial Fisheries Institute it has been shown that this is not unusual in the ordinary farm pond depending on run-off water only, as the conditions for successful spawning are invariably absent.

LITERATURE

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A PRELIMINARY ACCOUNT OF THE VEGETATION OF THE MARIEPSKOP COMPLEX*

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THE Mariepskop area is situated in the Transvaal Drakensberg Mountains about twenty miles west of Klaserie Station. It consists of the Mariepskop-Magalieskop complex which is separated from the rest of the range by a tributary of the Klaserie River and by the Blyde River. The latter forms a deep canyon in the Drakensberg Mountains. The Klaserie River rises in the rain forests on the southern slopes of Mariepskop. It is a perennial stream that provides irrigation water for the riparian farmers in the Low Veld. The two valleys referred to are not only of importance because they separate the area from the rest of the escarpment, but also because they form migration routes for the Low Veld flora westwards and for the montane flora to the Low Veld. The flora of the Blyde River Valley is clearly related

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* The area whose vegetation is dealt with here lies in the proposed Blyde River Canyon Recreational area.—Editor.

1. Blyde River Canyon.

to that of the Low Veld, whereas the Klaserie Valley is the migration route for both the montane forests to the Low Veld and the gallery forest of the latter to the foot-hills of the mountains.

According to du Toit (1954), Mariepskop is part of the erosion resisting quartzites of the Black Reef Series that extends from Duiwelskantoor near Kaapse Hoop to the Wolkberg and Iron Crown. "The quartzites weather in the peculiar and fantastic manner of the Table Mountain Sandstone, are vertically jointed and give rise to scenery of considerable grandeur (Fig. 1), the rugged grey crags of the Escarpment contrasted with the rounded, grassy, and often forested granitic slopes of the 'Low Veld' beneath". (du Toit, 1954.)

At the Mariepskop Forestry Station the mean annual rainfall over a period of 25 years is 53·78 in. (1366·89 mm), and the average number of days per year on which rain falls is 96·20. The wettest months are December, January, and February with average monthly means of 8·06 in., 9·64 in. and 11·21 in. respectively, and an average of 12·72, 14·24 and 13·48 rainy days per month. The driest months are June, July and August with 2·36, 2·24 and 3·44 rainy days respectively and average precipitations of 0·92 in., 0·75 in. and 0·82 per month. Heavy downpours of 2 inches and more within 24 hours are frequent, and mist is of general occurrence (Fig. 2).

It should be noted that these rainfall figures are applicable only for the immediate vicinity of the forestry station. Judged by the vegetation, there can be little doubt that precipitation is probably much higher in the sheltered southern and south-eastern kloofs at higher altitudes, whereas it is probably much lower along the foot-hills and in the Blyde River valley.

As the result of observations and surveys made hitherto, the vegetation may tentatively be divided into the following communities:

1. Low Veld Sour Bushveld Communities of the Blyde River Valley, the foot-hills and the northern and western slopes of the mountain.
2. High mountain sour grass veld.
3. Montane forest.
4. Widdringtonia communities.
5. Communities of the mountain plateau.
6. Indigenous communities in plantations.

1. Low Veld Sour Bushveld Communities of the Blyde River Valley, the Foot-hills and the Northern and Western Slopes of the Mountain.

This plant community is a continuation of Acocks's (1952) Low Veld Sour Bushveld or v.d. Schijff's (1958) Large-leaved Deciduous Bushveld with tall grass. It occurs in the Blyde River Valley, on the eastern foot-hills of the Drakensberg below the Forestry Station at Mariepskop, and on the western and northern slopes of Mariepskop. The area is rather broken and the vegetation varies from relatively open bushveld, with long grass on the undulating hills and on the slopes, through dense brushwood and scrub in the dongas and dry ravines, to patches of semi-montane forest in sheltered kloofs. On the banks of the Blyde and the Klaserie River typical Low Veld gallery forest is met with, including such well-known and prominent Low Veld trees and shrubs as Matumie (*Adina microcephala* var. *galpinii*), Cape Wild Fig (*Ficus capensis*), Sycomore Fig (*F. sycomorus*), Tree Fuchsia (*Schotia brachypetala*), Tambotie (*Spirostachys africanus*), Water-berry (*Syzygium cordatum*), Water-pear (*S. guineense*), Transvaal Ebony (*Diospyros mespiliformis*), Mountain Ash (*Ekebergia capensis*), Leadwood (*Combretum imberbe*), Quinine Tree (*Rauvolfia caffra*), Natal Mahogany (*Trichilia emetica*), Enkeldoring (*Acacia robusta*), Flame Thorn Tree (*Acacia

2. Mist on the mountains in the early morning.

ataxacantha), Low Veld Bauhinia (*Bauhinia galpinii*), Wild Date-Palm (*Phoenix reclinata*), Mtserie (*Bridelia micrantha*), Bush-Willow (*Combretum erythrophyllum*), Sweet Thorn (*Acacia karroo*) and *Antidesma venosum.*

On the hills and slopes characteristic trees and shrubs are: *Annona senegalensis*, *Antidesma venosum*, Sickle Bush (*Dicrostachys cinerea* ssp. *glomerata*), Mobola Plum (*Parinari curatellifolium* ssp. *mobola*), Marula (*Sclerocarya birrea*), Wild grape (*Rhoicissus tridentata*), Boekenhout (*Faurea speciosa*), Red Boekenhout (*F. saligna*), *Maytenus peduncularis*, *Iboza riparia*, Rosyntjiebosse (*Grewia flavescens* and *G. monticola*), Red thorn (*Acacia gerrardii*), Natal Camelthorn (*A. sieberiana* var. *woodii*), Kaffir Thorn (*A. caffra*), *A. davyi*, Lucky-bean climber (*Abrus precatorius*), *Aloe marlothii*, Wild pear (*Dombeya rotundifolia*), Kei apple (*Flacourtia indica*), Peters' Wild Fig (*Ficus petersii*), Lavender Tree (*Heteropyxis natalensis*), Lemon Thorn (*Fagara capensis*), *Ficus ingens*, Dikbas (*Lannea discolor*), Baster maroela (*L. edulis*), Noupitjie (*Pappea capensis*), African Wattle (*Peltophorum africanum*), *Catha edulis*, Sour Plum (*Ximenia caffra* var. *natalensis*), Wild Medlar (*Vangueria infausta*), Buffalo Thorn (*Ziziphus mucronata*), Raasblaar (*Combretum zeyheri*), Red Bush-willow (*Combretum apiculatum*), Kiaat (*Pterocarpus angolensis*), Round-leaf Kiaat (*P. rotundifolius*), Leadwood (*Combretum imberbe*), Natal Cabbage Tree (*Cussonia natalensis*) and Guarri (*Euclea divinorum*). The grass cover, though sometimes dense, consists of relatively low-growing types among which the following are the most conspicuous species: *Panicum maximum*, *Themeda triandra*, *Andropogon amplectens*, *Hyparrhenia dissoluta*, *H. tamba*, *H. hirta*, *Loudetia simplex*, *Eragrostis superba*, *E. capensis*, *Perotis patens*, *Brachiaria serrata*, *Eustachys paspaloides*, *Eulalia villosa*, *Rhynchelytrum repens*, *Tristachya* sp., *Trachypogon spicatus* and *Setaria flabellata*.

On rocky ridges and shallow ground the following kinds of characteristic

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trees and shrubs are found: Mountain Seringa (*Kirkia wilmsii*), Sneezewood (*Ptaeroxylon obliquum*), *Terminalia phanerophlebia*, Transvaal Carrot Tree (*Steganotaenia araliacea*), Giant Nettle (*Urera tenax*), Natal Cabbage Tree (*Cussonia natalensis*), *Aloe marlothii*, Red Bush-willow (*Combretum apiculatum*), *Grewia monticola*, *Ficus sonderi*, Moepel (*Minusops zeyheri*), Melktou (*Sarcostemma viminale*), *Euphorbia triangularis*, *E. tirucalli*, Boerboon (*Schotia brachypetala*), Noupitjie (*Pappea capensis*) and *Ficus ingens*.

In moist sheltered kloofs higher up on the mountain slopes and in the Blyde River Canyon the vegetation changes into semi-montane forest with the following characteristic kinds of trees: White Stinkwood (*Celtis africana*), *Homalium* sp., Cape Wild Fig (*Ficus capensis*), Sneezewood (*Ptaeroxylon obliquum*), Mountain Ash (*Ekebergia capensis*), *Rhus legatii*, Moepel (*Mimusops zeyheri*), Water-berry (*Syzygium cordatum*), Forest Fever Tree (*Anthocleista grandiflora*), Kaffirboom (*Erythrina lysistemon*), *Halleria lucida*, *Pittosporum viridiflorum*, *Croton sylvaticus*, *Trimeria grandifolia*, *Cussonia spicata*, *Warburgia ugandensis* and *Protorhus longifolia*. Lianas that can be expected in these forest patches include *Dalbergia armata*, Wild grape (*Rhoicissus tomentosa*), *R. tridentata*, *R. revoilii*, *Grewia occidentalis*, *Smilax kraussiana*, *Pterolobium exosum*, *Entada spicata* and *Acacia ataxacantha*.

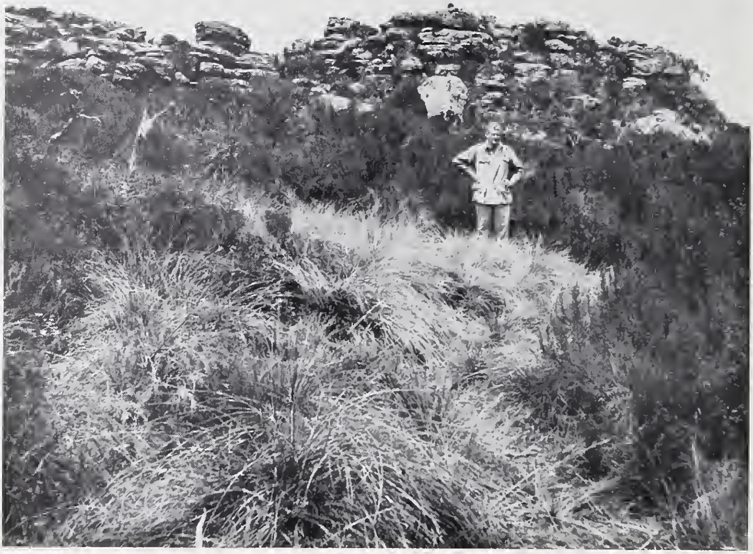
On the eastern foot-hills these communities have mostly been replaced by plantations, but on the northern and western slopes the natural vegetation is still relatively intact.

2. High Mountain Sour Grass Veld

This veld type is characteristic of the less moist and/or unsheltered ridges between wooded kloofs on the southern and south-eastern slopes, and also of the plateaus on the mountain summits of the Drakensberg. But there are also isolated patches of mountain grass veld scattered in the mountain forest communities. Good examples can be seen in the vicinity of Colonel Reitz's grave and along the Blyde River foot-path. Frequently these patches of grass veld are sponges for the mountain rivulets that constitute the head-waters of the Klaserie River and are associated with hygrophilous species of shrubs and herbs like *Cliffortia linearifolia*, *Erica leucopetala* var. *luxurians*, *Hemizygia albiflora*, *Hypericum revolutum*, *Gunnera perpensa* and *Thelypteris palustris* var. *squamigera* (Fig. 3).

The typical mesophytic mountain grass veld consists of a mixture of short sour grass of which some species like *Danthonia drakensbergensis* which is dominant form tussocks. Characteristic grasses of this community are *Eragrostis sclerantha*, *E. caesia*, *E. capensis*, *Agrostis burbuligera* var. *longipilosa*, *Harpechloa falx*, *Loudetia simplex*, *Panicum* sp., *Sporobolus eylesii*, *Themeda triandra*, *Stiburus alopecuroides*, *Trichopteryx dregeana*, *Andropogon distachys*, *Eulalia villosa* and *Tristachya hispida*. The most important of shrubs and herbs associated with this grass veld are *Protea rouppelliae*, *P. rhodantha* var. *rhodantha*, *P. gaguedi*, *Cliffortia linearifolia*, *Erica leucopetala* var. *luxurians*, *E. drakensbergensis*, *Lopholaena disticha*, *Mohria caffrorum*, *Helichrysum lepidissimum*, *H. latifolium*, *H. wilmsii*, *H. odoratissimum*, *H. platypterum*, *H. appendiculatum*, *Smithia thymodora*, *Moraea spathulata*, *Cheilanthes multifida*, *Vaccinium exul*, *Kniphofia praecox*, *Restio sieberi* var. *schoenoides*, *Tetraria cuspidata*, *Scirpus macer*, *Vernonia corymbosa*, *Crotalaria doidgeae* and *Teedia lucida*.

The largest patches of sour grass veld have gradually been replaced by pine plantations, whereas the small patches that have remained higher up on the mountain are being invaded by "wild" pines of the species *Pinus patula*. Much of the grass veld around Colonel Reitz's grave has already been replaced by this species.



3. High mountain grass veld in the foreground with macchia at the back.

3. **Montane Forest** (Fig. 4)

A very large part of the Mariepskop–Magalieskop complex is covered with evergreen montane forest or rain forest. In the deep kloofs and on the southern or south-eastern slopes these forests attain their maximum development. In these kloofs the forest extends far down and eventually merges into the semi-montane forest of the Drakensberg foothills, and this in turn into the gallery forest of the perennial rivers of the Low Veld.

As far as its species composition is concerned, the true montane forest higher up on the mountain is tropical in nature with affinities with the tropical forest of the eastern coastbelt as well as to the patches of tropical montane forest to the south and north on the eastern escarpment of South Africa. Some of the components occurring here are characteristic of the patches of montane forest of the rest of the eastern escarpment. These include Yellowwood (*Podocarpus latifolius* and *P. falcatus*), Black-bark (*Diospyros whyteana*), Cape Wild Fig (*Ficus capensis*), Wild Peach (*Kiggelaria africana*), Terblaans (*Faurea macnaughtonii*), *Pittosporum viridiflorum*, Waterboom (*Ilex mitis*), Cape Beach (*Rapanea melanophoeos*), White or Camdeboo Stinkwood (*Celtis africana*), White Olive (*Halleria lucida*), White Pear (*Apodytes dimidiata*), Assegai (*Curtisia dentata*), Cape Chestnut (*Calodendrum capense*), Knobwood (*Fagara davyi*), Red Current (*Rhus legatii*), Black Ironwood (*Olea capensis* spp. *macrocarpa*) and the White Elder (*Nuxia floribunda*).

Where the forest attains its maximum development four strata can be distinguished, viz.: (1) the tree stratum formed by the dominant species of trees, (2) the small tree stratum consisting of shade-loving (scotophilus) species growing in the shade of the dominants, (3) the shrub stratum formed by woody shrubs and suffrutescent herbs like *Plectranthus* species and (4) the shade and moisture-loving floor vegetation (Fig. 5).

Hitherto the following have been found to be the commonest species of trees of the tree stratum: Yellowwood (*Podocarpus falcatus* and *P. latifolius*), Forest Cabbage-Tree (*Cussonia umbellifera*), *Ochna oconnori*, Assegai (*Curtisia dentata*), Wild Peach (*Kiggelaria africana*), White Elder (*Nuxia floribunda*), *N. congesta*, White Pear (*Apodytes dimidiata*), *Brachylaena discolor*), Bush-Willow (*Combretum kraussii*), Black-bark (*Diospyros whyteana*), Cape Holly (*Ilex mitis*), Water Pear (*Syzygium gerrardii*), *Schrebera alata*, Terblaans (*Faurea macnaughtonii*), Strangler Fig (*Ficus petersii*), *Xymalos monospora*, White Stinkwood (*Celtis africana*), White Olive (*Halleria lucida*), Red Stinkwood (*Pygeum africanum*), Black Ironwood (*Olea capensis* ssp. *macrocarpa* and *Olea woodiana*), *Pterocelastrus echinatus*, *Bersama tysoniana*, *Trichocladus grandiflorus*, *Protorhus longifolia* and the Cabbage Tree (*Cussonia spicata*).

In the shade-loving small-tree stratum *Rawsonia lucida*, Knobwood (*Fagara davyi*), *Trimeria grandifolia*, *Rhus legatii*, *Rothmannia capensis*, *Tricalysia capensis*, *Oxyanthus gerrardii*, *Grumilia capensis*, *G. kirkii*, *Calpurnia subdecandra*, *Croton sylvaticus* and *Ekebergia pterophylla* are the commonest species.

The shrub stratum is a heterogeneous community that varies with the aspect and the amount of light that penetrates the two higher strata. It is best developed along the forest margins, where it sometimes forms dense thickets. The most characteristic components of this stratum are, among others, *Bowkeria cymosa*, *Schlerochiton harveyanus*, *Mackaya bella*, *Pavetta lanceolata*, *Vangueria cyanescens*, *Duvernoia adhotodioides* and *Canthium obovatum*.

Like the schrub stratum the floor vegetation varies appreciably with light intensity. It consists exclusively of dependent herbs and herb-like species which are sometimes specific for a definite habitat. Where the tree and shrub strata are very well developed and the light is consequently poor, the floor vegetation is in many cases totally wanting or limited to species like *Carex spicatopaniculata*, *Galopina circaeoides*, *Thalictrum rhynchocarpum*, *Clivia caulescens*, *Selaginella kraussiana* and the grass *Oplismenus hirtellus* which is able to grow in dense shade. Other species characteristic of this stratum include *Impatiens sylvicola*, *I. duthieae*, *Cardamine africana*, *Pseudobromus africanus*, *Begonia* spp., *Fleurya mitis*, *Harveya coccinea*, *Peperomia retusa*, *Hypoestes verticillaris*, various kinds of ferns (Pteridophyta) like *Marattia fraxinea*, *Todea barbara*, *Blechnum capense*, *B. attenuatum*, *Anemia dregeana*, *Asplenium* spp., *Dryopteris kirkii*, *Hemitelia capensis*, *Hypolepis sparsisora*, *Pteris quadriaurita* and *Streptocarpus* species like *S. micrantha* and S. *haygarthii*. Where there is more light, the floor vegetation is fairly dense and *Plectranthus* species as well as members of the Acanthaceae like *Barleria gueinzii* are prominent.

A conspicuous feature of this montane forest is the variety of lianas and epiphytes. Among lianas the following are most conspicuous in the forest itself: *Canthium gueinzii*, *Rhoicissus rhomboidea*, *R. revoilii*, *R. tomentosa*, *Secamone alpinii*, *S. gerrardii*, *Riocreuxia torulosa*, *Jasminum abyssinicum*, *J. fluminense*, *Landolphia capensis*, *Cnestis natalensis*, *Smilax kraussiana*, *Behnia reticulata*, *Stephania abyssinica*, *Helinus integrifolius* and *Quisqualis parviflora*. In some localities along the edge of the forest *Rubus rigidus*, *Sphedamnocarpus galphimiifolius*, *Dioscorea retusa*, *Senecio tamoides*, *S. quinquelobus* and *Mikania cordata* form an impenetrable scrub or thickets together with shrubs like *Hypericum revolutum*, *Pteridium aquilinum*, *Buddleia salvifolia* and *Plectranthus* spp. Lower down in the kloofs, where elements of the Low Veld flora become more prominent, the most conspicuous lianas

4. Mountain forest on the southern slopes of Mariepskop.

are *Rhoicissus tridentata*, *Adenia gummifera*, *Dalbergia armata*, *Acacia ataxacantha* and *Pterolobium exosum*.

Most epiphytes recorded belong to the Pteridophyta and the families Orchidaceae and Gesneriaceae of the higher plants, whereas epiphytic and epiphyllous mosses and lichens are also plentiful. The most important epiphytic Pteridophyta are *Vittaria isoetifolia*, *Lycopodium verticillatum*, *L. dacrydioides*, *Polypodium ecklonii*, *Pleopeltis lanceolata*, *Loxogramma lanceolatum*, *Asplenium sandersonii*, *A. anisophyllum*, *A. splendens* and *Elaphoglossum angustatum*, and the most common epiphytic orchids are *Tridactyle tricuspis*, *Mystacidium capense*, *Bulbophyllum sandersonii* and *Angraecum sacciferum*. Of the Gesneriaceae *Streptocarpus haygarthii*, *S. micrantha* and *S. wilmsii* are well-known epiphytes, but they also grow on rocks in the forest. In some areas *Clivia caulescens* (Amaryllidaceae) usually found on the forest floor is one of the most conspicuous epiphytes.

4. **Widdringtonia Communities** (Fig. 6).

These communities occur on the southern and south-eastern cliffs just below the summit of the mountain and also in fissures and kloofs and between huge boulders on top of the mountain. Where the habitat is favourable for this community, as for example in the kloof south of the trigonometrical beacon on top of the mountain, practically pure stands of *Widdringtonia whytei* with fairly large trees are found. But between the boulders on top of the mountain, where the vegetation is exposed to mountain winds, the trees are often stunted. On the mountain top this Widdringtonia scrub is associated with shrubs and trees like *Rhus dura*, *Cliffortia nitidula*, *Podocarpus latifolius*, *Phylica paniculata* and *Cassine eucleaeformis*. On the slopes below the summit *W. whytei* occurs in association with various typical forest trees like *Olea woodiana*, *Podocarpus latifolius*, *Xymalos monospora*, *Schrebera alata*, *Pterocelastrus echinatus* and *Myrica pilulifera*.

5. Mountain Plateau Communities

In general the plateau on top of Mariepskop is fairly bare and vegetation is found principally in sheltered places between the boulders. Grasses and other herbaceous plants are relatively rare, whereas quite a number of woody plants found here are sclerophyllous. Between the rocks and where the water-table is near the surface typical heath-like shrubs are found with species like *Passerina montana*, *Erica leucopetala* var. *ephebioides*, *E. leu-*

5. Dense mountain forest.

Photo: E. K. Marsh.

6. Widdringtonia community in a kloof of Mariepskop. Many trees are covered with a lichen (*Usnea* sp.).

Photo: E. K. Marsh.

copetala var. *luxurians*, *E. woodii*, *Vaccinium exul*, *Cliffortia serpyllifolia*, *C. nitidula* ssp. *pilosa*, *Passerina montana*, *Phylica paniculata*, *Psoralea pinnata* and *Muraltia flanaganii* dominant. On the same type of habitat and often together with the fynbos, scattered communities of *Protea roupelliae*, *P. rhodantha* var. *rhodantha* and *P. gaguedi* are found.

Other characteristic plants of the mountain plateau are: *Anisopappus junodii*, *Otiophora cupheoides*, *Anthospermum hispidulum*, *Eumorphia davyi*, *Hemizygia albiflora*, *Silene burchellii*, *Hebenstreitia comosa*, *Agapanthus inapertus*, *Zaluzianskya katherinae*, *Cineraria fruticetorum*, *Crassula browniana*, *C. setulosa*, *C. parvisepala*, *Kniphofia obtusiloba*, *Watsonia densiflora*, *Euryops rogersii*, *Selago villosa*, *S. nelsonii*, *Eragrostis caesia*, *Craterostigma wilmsii*, *C. plantagineum*, *Plectranthus fruticosus*, *Nemesia melissaefolia*, *Macowania tenuifolia*, *Helichrysum* spp., *Carex zuluensis*, *Sebaea erosa*, *Monopsis kowynensis*, *Hesperantha baurii*, *Albuca fastigiata*, *Lopholaena disticha* and various members of the Pteridophyta.

From the botanical point of view these plateau communities are of special interest, because as regard to composition and physiognomy they show affinities with the macchia of the South-Western Cape and also with the scrub flora of the high mountains of the rest of the East African mountain chains, of which Mariepskop forms a part. Representatives of various genera like *Erica*, *Protea*, *Otiophora*, *Phylica*, *Restio* and *Cliffortia* and also species like *Cliffortia nitidula*, *Passerina montana*, *Widdringtonia whytei*, *Myrsine africana* and *Smithia thymodora* are also recorded by Phipps and Goodier (1962) from the scrub of the Chimanimani Mountains on the eastern boundry of Southern Rhodesia.

7. Plateau area south of Mariepskop from Mariepskop Mountain.
Photo: E. K. Marsh.

6. Indigenous Communities in Plantations

The composition and plant succession of indigenous communities in plantations requires more attention. In the higher areas with a southern or south-eastern aspect, it seems as if the succession will eventually result in a montane forest climax. The fact that some of these pine plantations are relatively young favours the study of such regeneration. Hitherto there has been no selective eradication of the undergrowth invading the young pine plantations. The undergrowth is cut out indiscriminately with the result that pioneer seedlings of the montane forest and of true forest trees are also eradicated.

Shrubs that have hitherto been found in the pine plantations include *Clerodendrum glabrum*, *Vernonia shirensis*, *Hibiscus meeusei*, *Pycnostachys urticifolia*, *Rhus intermedia*, *Lippia javanica*, *Smilax kraussiana*, *Dombeya pulchra*, *Antidesma venosum*, *Adenia gummifera*, *Cassia petersiana*, *Rhoicissus tridentata*, *Maesa lanceolata*, *Trema guineensis*, *Heteropyxis natalensis*, *Dalbergia armata* and the exotic liana *Caesalpinia sepiaria*.

THE AFFINITIES OF THE FLORA

Of the considerable number of interesting species collected in the area, the following deserve special mention: the ferns *Pyrrosia schimperiana* (Schweickerdt 2610, v.d.S. 5505) and *Hymenephyllum capillare* (v.d.S. 4872), the lichen *Cladonia rangiformis?* (v.d.S. 5602) and the fire lily *Cyrtanthus huttonii* (v.d.S. 4564). As far as could be ascertained, *Pyrrosia schimperiana* and *Hymenephyllum capillare* have not previously been collected within South Africa, and the only specimen of *Cladonia rangiformis* in the National Herbarium in Pretoria is from the Congo. The distribution of

Cyrtanthus huttonii, which is abundant underneath cliffs that face south and south-east on top of Mariepskop, requires further study. The nearest locality of this species to Mariepskop is the Katberg in the Eastern Cape Province. Phytogeographically the flora of Mariepskop is of special importance, because it is clear that it is an unusually interesting floral area.

The presence of species of predominantly southern genera like *Protea*, *Erica* and *Passerina* in the communities on the mountain plateau and also in the scrub of the Chimanimani Mountains (Phipps and Goodier, 1962) proves that the eastern mountain ranges form a migration route for the sclerophyll flora of the South-Western Cape. On the other hand, the montane forests have strong affinities with the forests of tropical East Africa as found at Mount Salinda and the Chimanimani Mountains. Hence the Drakensberg Range forms a common migration route for both the southern and the tropical elements of our indigenous flora.

SUMMARY

The Mariepskop Complex lies in the Eastern Transvaal Drakensberg and is part of the Eastern Escarpment that extends from the Cape Province northwards.

At the forestry station the average rainfall amounts to 53·8 in. per annum, the wettest months being December, January and February. In the sheltered kloofs facing east and south-east precipitation judged by the vegetation is probably much higher.

The natural vegetation is tentatively divided into five communities, whereas indigenous shrubs and trees found in the pine plantations are dealt with as a separate veld type.

Low Veld Sour Bushveld occurs in the Blyde River Valley and on the foot-hills and the northern and western mountain slopes. The most conspicuous trees and shrubs of this community are *Faurea saligna*, *F. speciosa*, *Peltophorum africanum*, *Sclerocarya birrea* and *Parinari curatellifolia* ssp. *mobola*, whereas typical Low Veld gallery forest occurs on the river-banks.

High mountain sour grass veld is characteristic of the less moist and/or sheltered ridges between the wooded kloofs on the southern and south-eastern slopes, and also on the plateaus on the summit of the mountain. It is a short grass veld type the most conspicuous species being *Danthonia drakensbergensis*, *Loudetia simplex*, *Tristachya hispida* and *Andropogon distachyus*.

Evergreen montane forest with strong tropical affinities occurs in deep kloofs and in slopes facing south and south-east and is the most conspicuous component of the vegetation of this area.

On the southern and south-eastern cliffs just below the mountain summit and also in the fissures and kloofs and between huge boulders on the mountain there are striking *Widdringtonia whytei* communities. According to the habitat these communities vary from stunted shrubs to trees of appreciable size.

The communities on the mountain plateau show affinities with both the Cape macchia and the scrub of the Chimanimani Mountains.

The indigenous communities in pine plantations require closer study.

Phytogeographically the Drakensberg Range is of great importance because it forms a common migration route both for the tropical and the southern flora.

ACKNOWLEDGEMENTS

Sincere thanks for the financial assistance received from the University of Pretoria and the Department of Agricultural Technical Services are expressed. Thanks are extended to the Forestry Department for indispensable co-operation, and special thanks to the foresters P. R. E. Botha and J. H. Brisley for their willingness to help at all times. The staff of the National Herbarium in Pretoria is thanked for assistance in naming the material.

Miss V. V. Scherman is thanked for typing the manuscript.

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FERNS AND FERN ALLIES OF TRANSVAAL

Miss E. Y. Johansson

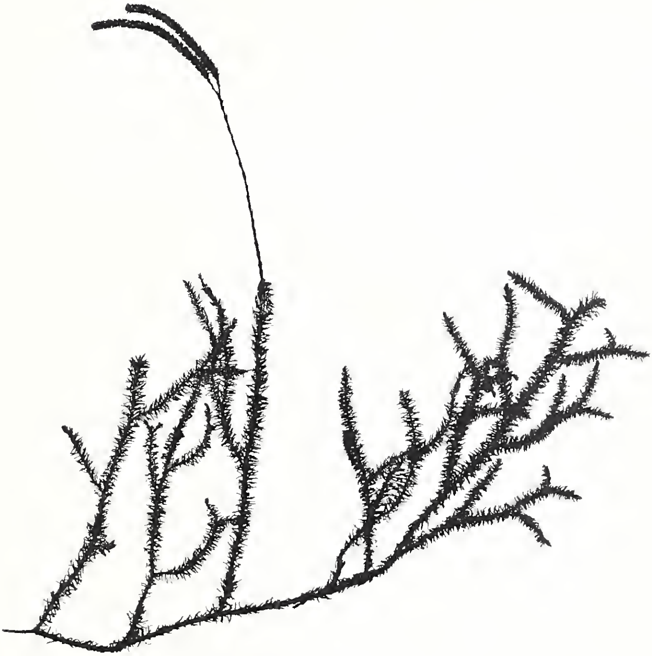

Fig. 1.—Lycopodium clavatum.

Introduction

There is a wide variety of ferns to be found in the Transvaal Province. Practically all the species growing in South Africa are represented in this Province. Unfortunately space does not permit a detailed treatment of all—there are nearly two hundred—but the more common ferns and a few of the interesting ones will be dealt with in this article. A check-list of all the Transvaal ferns appears at the end of this article.

Ferns are Cryptogams and as such belong to the division known as the Lower Orders of plants, because they do not bear flowers. In all ordinary flowering plants seeds are produced as the result of pollination and the subsequent fertilization of the egg-cell, i.e. by a sexual process. In the ferns, however, the capsules (called sporangia) produce the dust-like spores without fertilization taking place, i.e. asexually. These capsules are developed on the frond, grow simultaneously with it and reach maturity at the same time.

Anyone who examines a fertile frond of the common Bracken will find that the margin all along is closely folded back upon the under side of the frond and that under this reflexed edge there are numerous small bodies to be found. These are the capsules or sporangia. In many other ferns the sporangia are arranged in round dots or sometimes longitudinally in certain fixed positions on the under surface of the frond. These two characteristics: absence of flowers and asexual reproduction by means of spores, classify ferns as Cryptogams. Also classed as Cryptogams are such plants as mosses, lichens, seaweeds and fungi.

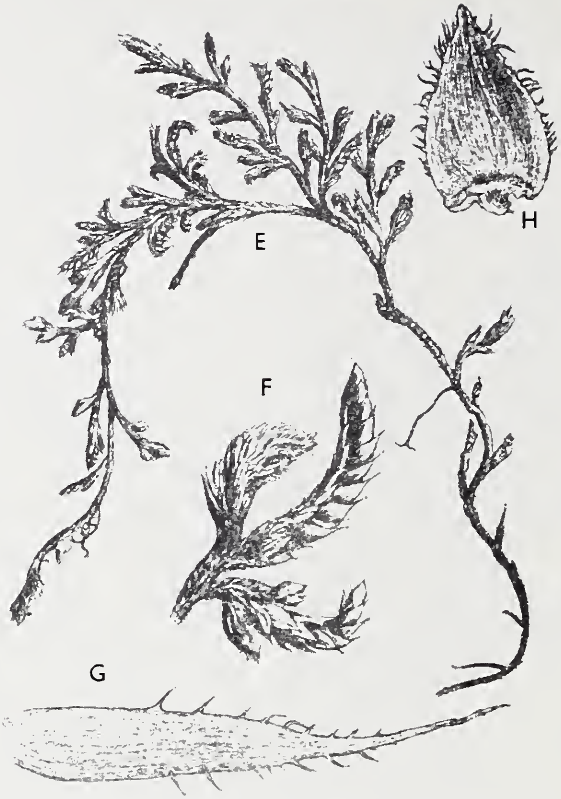

FIG. 2.—Selaginella dregei.
E—plant. F—fertile section or strobili. G and H—leaves.

Cryptogams are again divided into two groups: cellular and vascular Cryptogams; the former include lichens, algae, fungi and the Bryophyta (mosses), and the higher vascular Cryptogams are spoken of as Pteridophyta or, as they are familiarly termed, the ferns and fern allies.

Also peculiar to ferns is their life history, which differs greatly from that of flowering plants. There are two distinct vegetative forms alternating in the same plant. They are termed the gametophyte and sporophyte generations. When released by the bursting of the capsule, the spore floats in the air until some damp place is reached, whereupon it bursts its husk and produces an outgrowth which does not, as in the case of a seed produced from a flowering plant, consist of a root proper and an associated leaf or leaves, but forms instead a small, green, semi-translucent scale, more or less heart-shaped, which is closely attached to the soil by means of a number of root-like hairs. As growth continues, the scale or prothallus, as it is termed, increases in size until it measures perhaps a quarter of an inch in diameter, the two rounded lobes being fairly free of soil, while the root-hairs are clustered in the centre. At this stage, if the under side of the prothallus is examined with a good lens, it will be seen that among the root-hairs there are a number

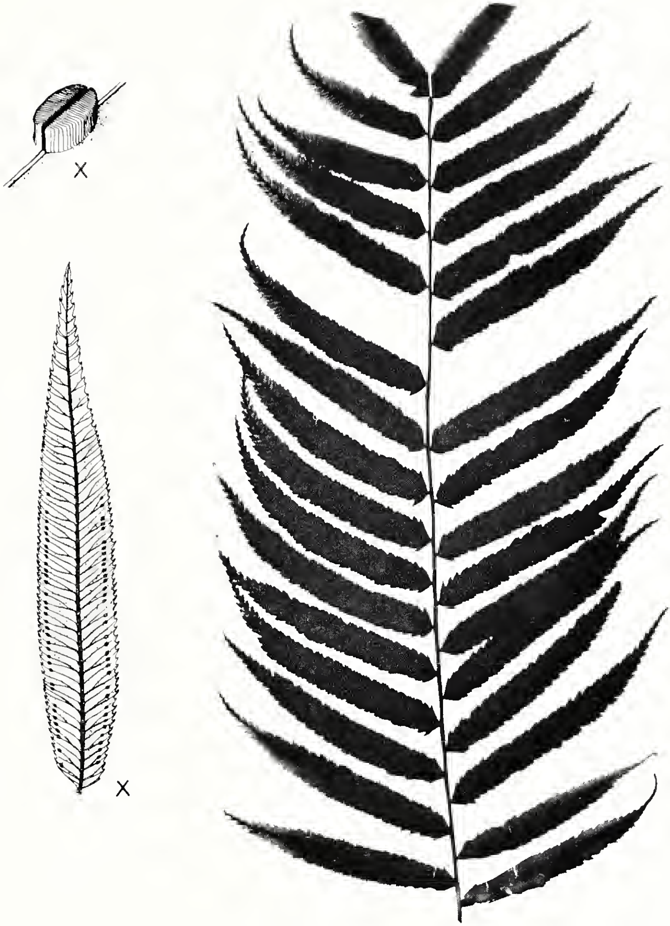

FIG. 3.—Marattia fraxinea var. salicifolia.
X (*above*)—enlargement of sorus. X (*below*)—enlargement of pinna.

of rounded projections irregularly scattered. These are the male organs termed antheridia. Close to the indentation of the heart-shaped scale, raised tubular projections called archegonia are to be found. These are the female organs. The antheridia contain a number of extremely minute spiral bodies known as spermatozoids, each crowned with a brush of fine cilia or hairs. When mature and under proper conditions of moisture, the antheridium bursts, releasing the spermatozoids which then begin actively to swim about by means of the cilia. The archegonia have an ovum or incipient seed embedded in the base of each tube. When wet, the mouth of the tube opens and the spermatozoids, moving in the water, find their way to the archegonia and thus fertilization takes place. It is a remarkable fact that, minute as the vegetative spermatozoids are, they are not only endowed with locomotive

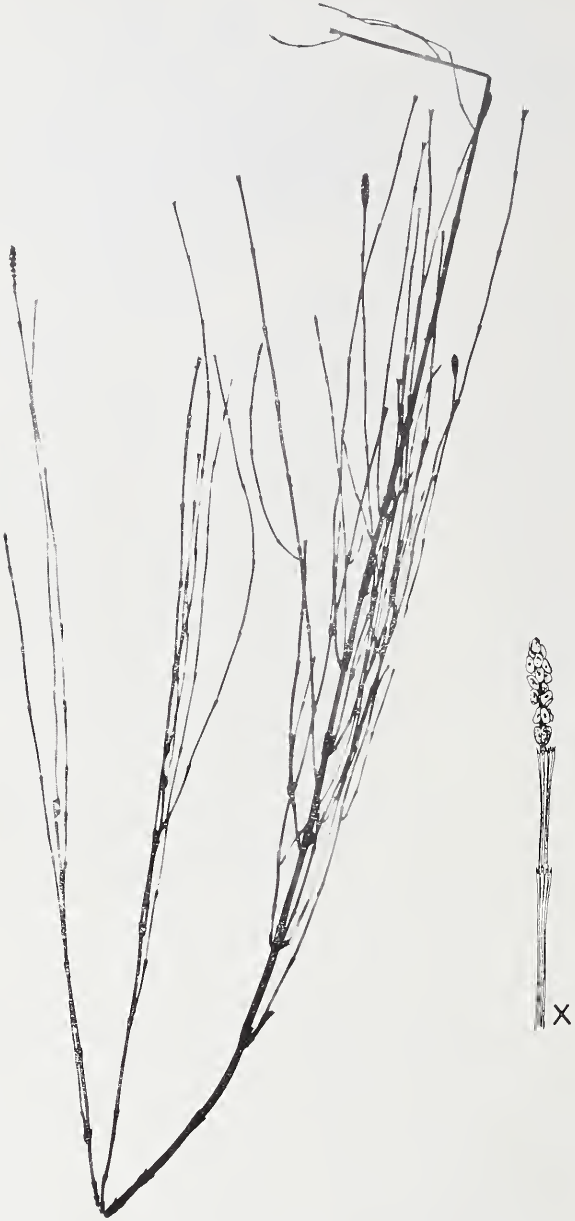

FIG. 4.—Equisetum ramosissimum.
X—enlargement of fertile branch.

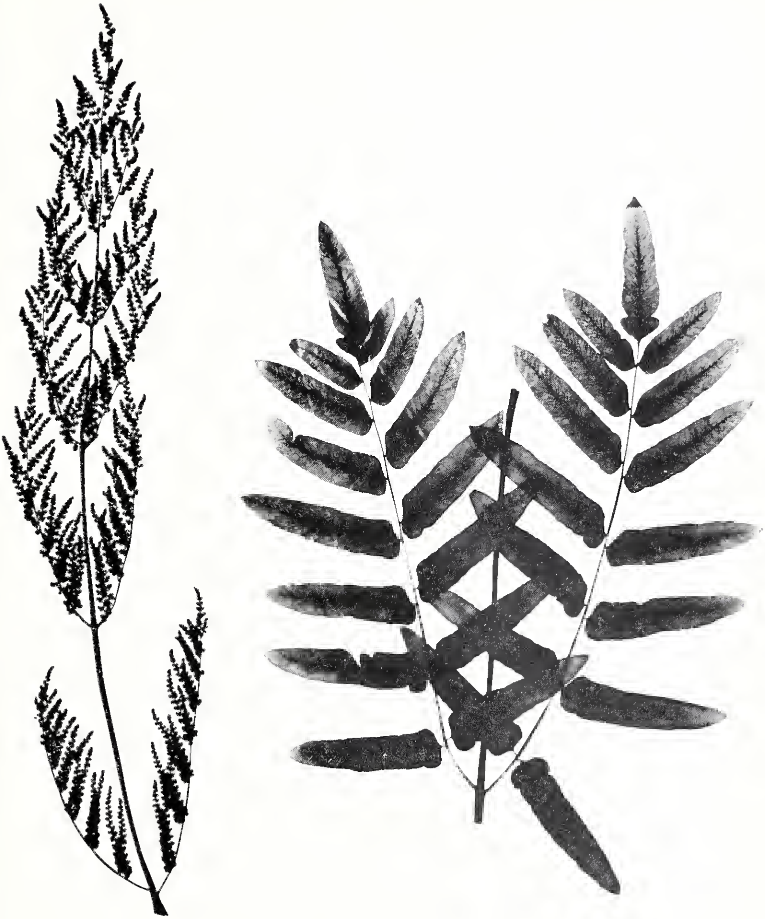

FIG. 5.—Osmunda regalis.

power but also with volition, since, when freely swimming, they will definitely travel towards a touch of malic acid applied to the scale; and it has been found that the archegonia, when mature, exude this acid, thus attracting the spermatozoids in the right direction. This development of the vegetative prothallus bearing sexual organs is called the gametophyte generation.

Instead of the fertilization resulting in seed, as is the case among the flowering plants, the product in this instance is a young plant which, growing like a bud out of the fertilized prothallus that soon after withers off, produces fronds and then roots; thus it develops into the more complex vegetative form—the fern as we know it—called the sporophyte generation, which, without further fertilization, produces its asexual reproductive spores.

The prothallus of each species has a distinct form of its own and usually both archegonia and antheridia occur upon it but, in some cases, antheridia

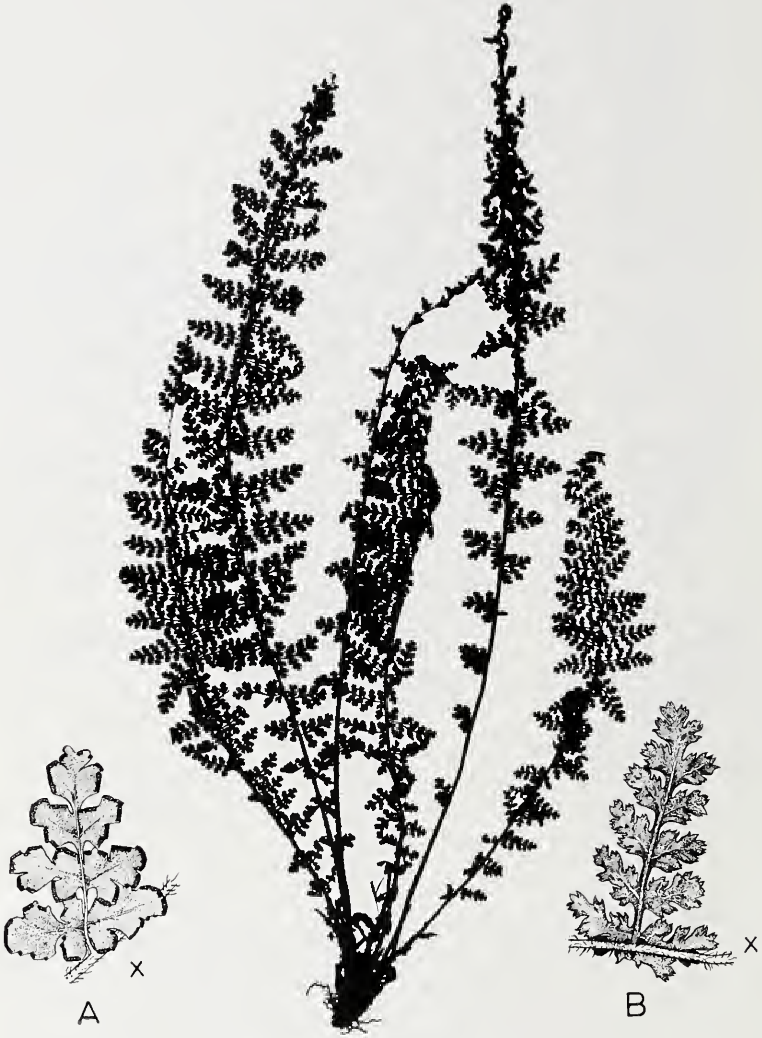

Fig. 6.—Mohria caffrorum.

A fertile section of the frond.
B sterile section of the frond.

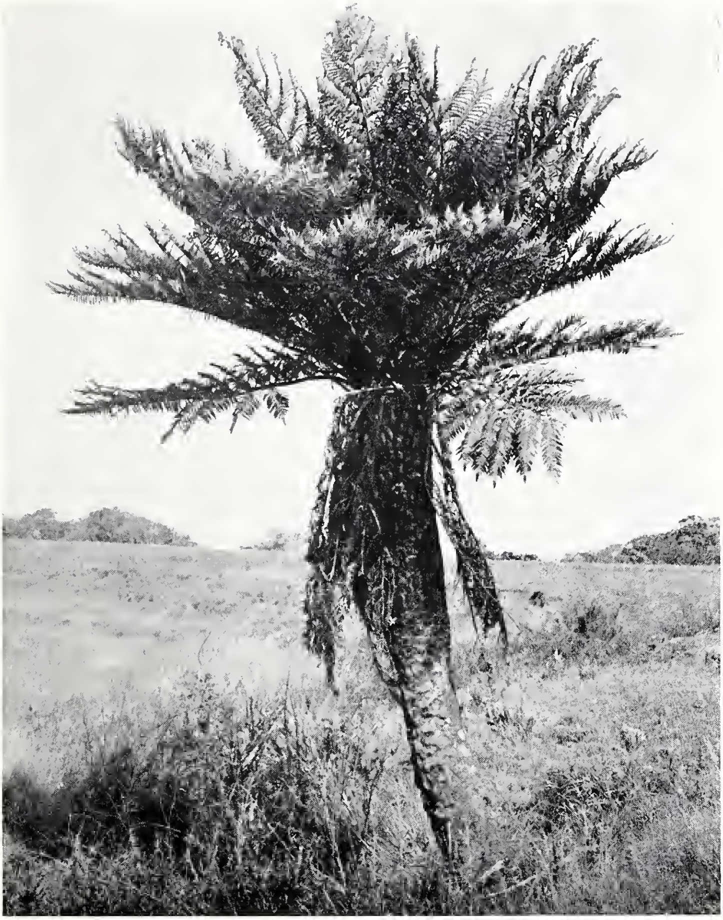

FIG. 7.—Cyathea dregei.

Tree fern on the Escarpment—Eastern Transvaal.

alone are produced on a prothallus; in these cases the prothallus is smaller or irregular. In some species spores of two kinds are produced, one giving rise to a prothallus bearing archegonia and the other to a prothallus bearing antheridia. The fern is then said to be dioecious. This may account for the difficulty experienced in propagating some kinds.

In the Transvaal we have such a varied topography and climate that fern species of great variety abound. Thus the distribution of various kinds of ferns depends upon the habitat.

Generally speaking, ferns enjoy a humid atmosphere and a certain amount of shade. Such conditions also favour the growth of trees. The distribution of forests and forest patches is almost confined to the eastern slopes

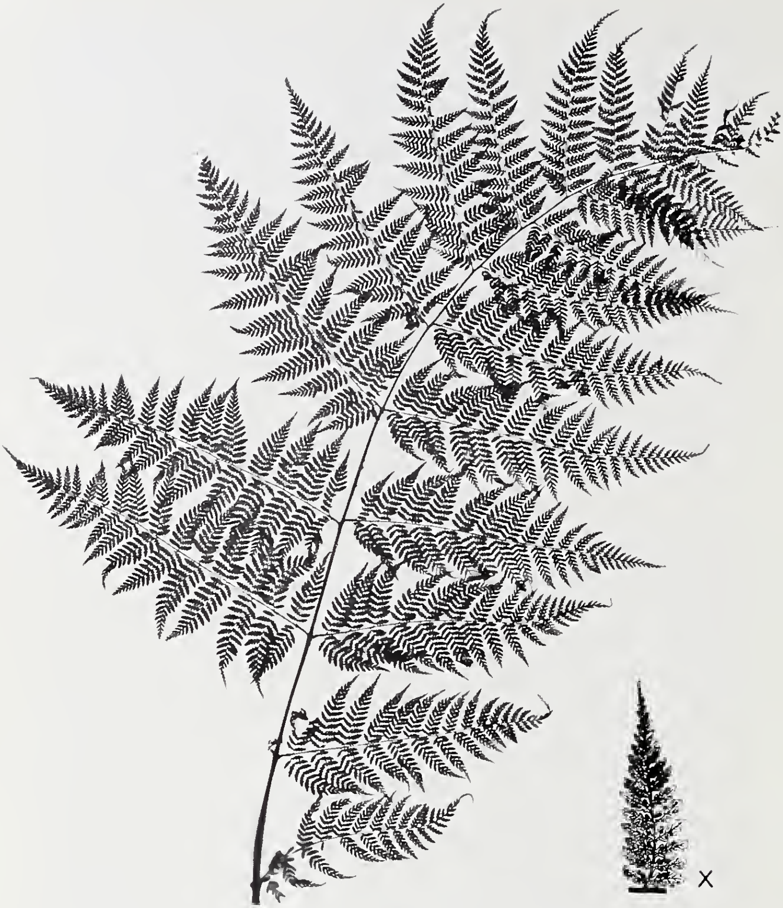

Fig. 8.—Hypolepis sparsisora.
X—enlargement of pinnule.

leading from the edge of the high central plateau of South Africa to the Indian Ocean. The distribution of ferns largely follows these same lines. Thus in the forests of the Transvaal Drakensberg and in the Soutpansberg a large number of species is to be found, especially in the Northern and Eastern Transvaal sections, where our fern flora is extremely rich.

Ferns also abound in the kloofs of mountains, particularly if there is a small stream running down a kloof or if it is fairly damp. Unfortunately these places are often visited by picnickers and the like, who wantonly destroy the ferns by uprooting them and then leaving them to die by the wayside. In this way whole areas where ferns once grew in profusion have been completely denuded.

Many ferns are also found growing along rocky banks, in ditches and in swamps or "vleis". Again, others belong to, or extend into the dry or

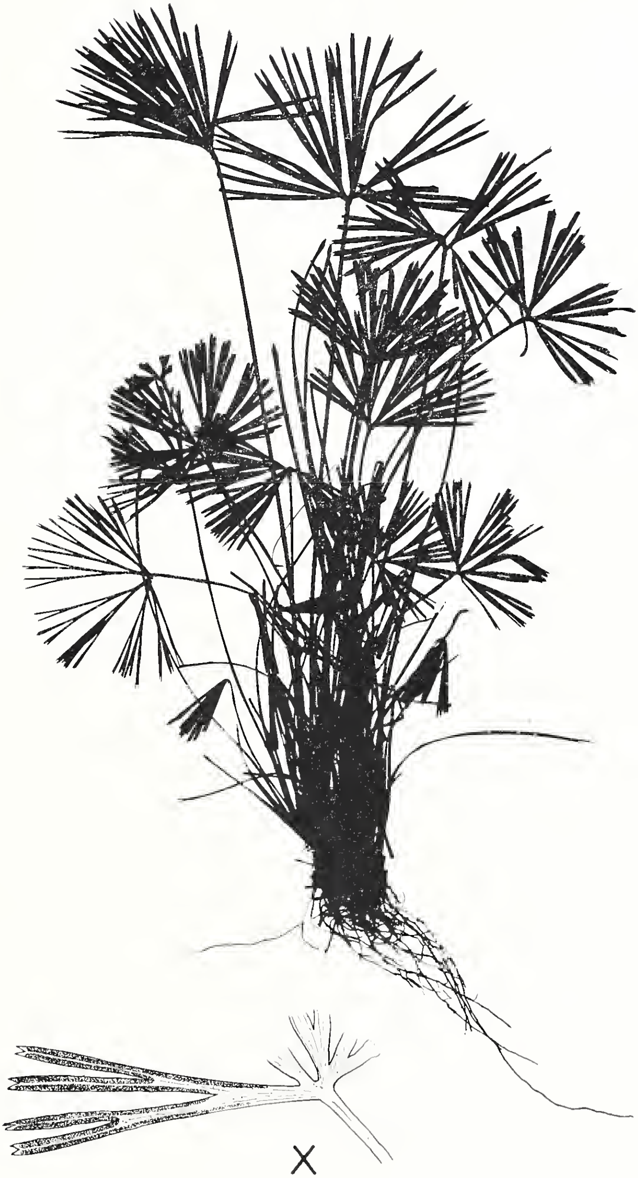

Fig. 9.—Actiniopteris radiata.
X—enlargement of pinnules.

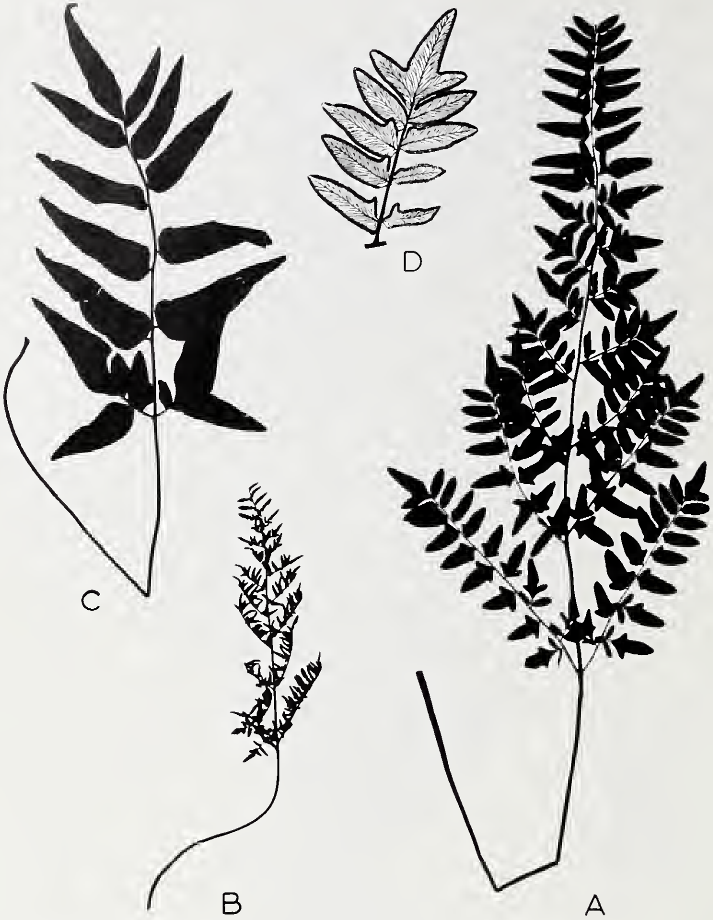

Fig. 10.

A Pellaea viridis.
B Pellaea viridis var. glauca.
C Pellaea viridis var. macrophylla.
D Enlargement of pinna of Pellaea viridis.

karroid regions, such as the High Veld. These xerophytic species, such as certain forms of *Cheilanthes hirta*, *Pellaea viridis* and *Pellaea calomelanos* are frequently subject to drought but have amazing vitality. Most of them are specially adapted to their conditions, either by being clothed in scales or hairs, or by being thick and leathery. Often these ferns are also subject to being burned in annual grass fires but without being seriously damaged. *Blechnum tabulare*, for instance, has its crown protected by a dense clothing of scales, and the undeveloped fronds are thus protected while the mature fronds are burned off. This is also frequently the case with the large tree fern *Cyathea dregei*.

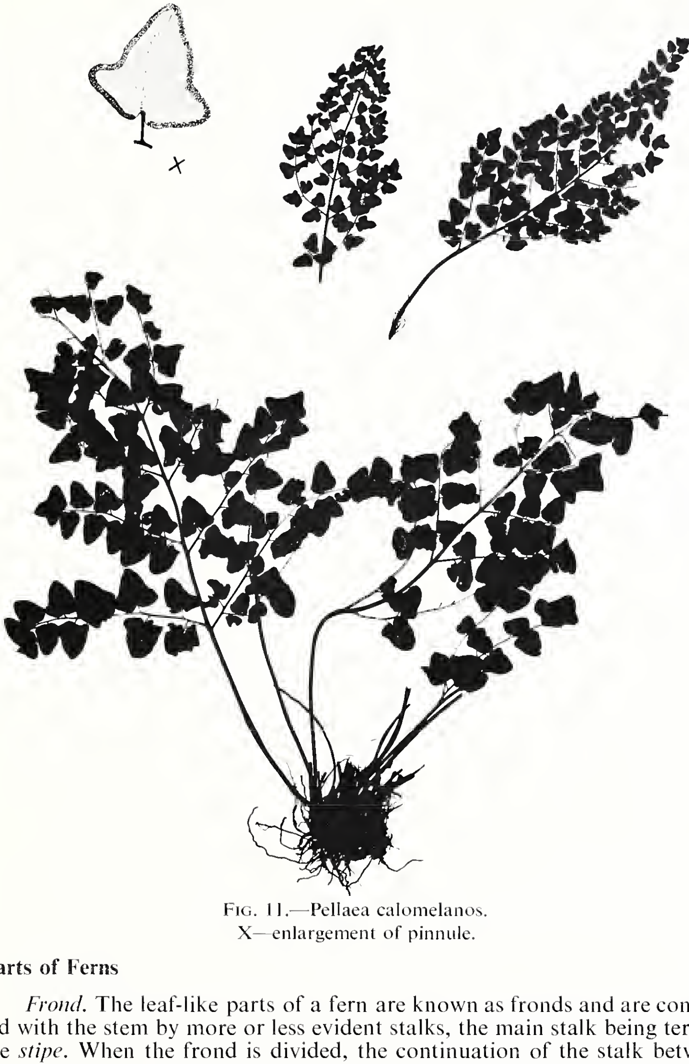

Fig. 11.—Pellaea calomelanos.
X—enlargement of pinnule.

Parts of Ferns

Frond. The leaf-like parts of a fern are known as fronds and are connected with the stem by more or less evident stalks, the main stalk being termed the *stipe*. When the frond is divided, the continuation of the stalk between the leafy parts is known as the *rachis*, and the same term is applied to its further continuation through the branches, while the still further continuation of it within the substance of the frond is known as the *costa* (mid-rib) and finally *veins*. If the frond be undivided it is said to be *simple*, and if cut down to the rachis it is *pinnate*, and each division is known as a *pinna*. When these *pinnae* are cut down to the pinna-rachis the frond is *bipinnate*, or 2-*pinnate*, and when the pinnae of these are again similarly cut, the frond is *tripinnate* or 3-*pinnate*, and a further repetition of this makes them 4-*pinnate*.

If instead of being cut to the rachis they are only partly cut, they are

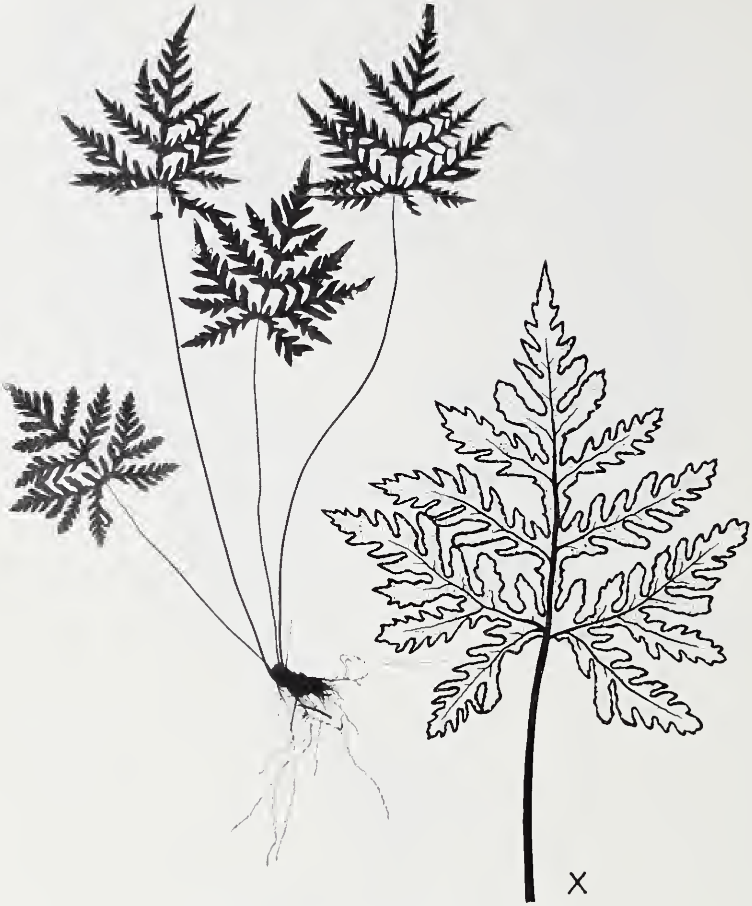

Fig. 12.—Doryopteris concolor var. kirkii.
X—enlargement of frond.

pinnatifid instead of pinnate, and frequently a frond, or a pinna, is pinnate below, and only pinnatifid above.

When the pinnatifid lobes are very unequal in size and are sometimes reduced to a waved outline, the frond is said to be *sinuate*.

When the stalk of a frond forks into two pinnae and these again into two, it is said to be *dichotomous*, as in the *Gleichenias*, where the main divisions are dichotomous and the final cutting pinnate. When a frond is 2, 3 or 4-pinnate, the final or undivided race of pinnae is known as *pinnules*. A *sinus* is the bottom of the cut separating two lobes.

Capsules or *sporangia* occur either in lines or groups which are known as *sori*, one line or group being a *sorus*. In many ferns the sorus is covered when young by a thin membranous covering known as the *indusium*, and when the sorus is marginal (in a line along the edge of the frond), this indusium is generally formed by the turned back margin, changed in texture more or less. In some ferns the sorus may also be placed inside a little membranous cup known as the *involucre*, and this term is also used where, instead of the cup, there is only a scale placed under the sorus. In certain kinds there is no indusium or involucre present at all.

Kinds of Ferns and Fern Allies

Lycopodium clavatum Linn: Club-moss or Tod's Tail, Wolf's Foot This is a low-growing plant, creeping along the ground, several yards long, pinnately branched, rooting at short intervals, generally with a long tail-like point behind which the branches are short and simple, then dichotomous, then repeatedly dichotomous, or pinnate. Branches all more or less ascending, sometimes rooting, the lower ones very much branched, 6–12 in. long or elongating into fresh stems. The latter are clothed all over with small, finely toothed, firm, green, awl-shaped leaves, loosely spreading with white hair points. Fertile part distinct, terminal on ordinary side branches, separated from the leafy part by a nearly naked stalk, 2–6 in. high, and divided into two, or sometimes into three or four, yellow shortly stalked spikes, 2–3 in. long, with spreading, ovate, ciliated, pointed bracts.

It is found growing on open grassy slopes, seldom below 4,000 feet altitude—mountainous regions of Northern Transvaal and the Low Veld.

Selaginella dregei (Presl) Hieron. This plant (a fern ally) is frequently mistaken for a moss. It grows on bare exposed rocks and in the dry season shrivels and appears to be dead, being silvery-grey in colour, but in rainy weather the plant revives turning silvery-green. Hence it is often called the Resurrection Plant. It is matted in appearance, due to the many small branches which are clothed all over with leaves, uniform round the stem. Leaves small, lanceolate, ciliated on the margins and having a long white hair-point; fertile spikes or strobili on the lower branches, not terminal, often in pairs; half-inch long, four-angled, the bracts in four regular keeled rows. Distribution: Bushveld, High Veld, Magaliesberg, Witwatersrand, Low Veld, Western Transvaal.

Marattia fraxinea Sw. var. *saliçifolia* (Schrad.) C. Chr. This is a large fern; the crown, from which all the fronds emanate, is large, irregular and erect. The fronds are 4–6 ft. long, leathery, glabrous (not hairy) and sharply toothed along the edges. The sporangia are borne on the under surface and are united into groups of sori which open by longitudinal slits. It belongs to the fossil family of Marattiaceae.

This fern always grows in forests and wooded mountain kloofs and is rather rare. It is found mainly in the northern and eastern sections of the Transvaal Drakensberg.

Equisetum ramosissimum Desf.: Horse-tail (Dronkgras). A very variable plant; root-stock a running rhizome, slender; stems erect, 1–6 ft. high, often simple and slender when small, when large 6–8 mm. in diameter, irregularly branched or whorled, terminal branch generally fertile, bearing oblong, pointed cones $\frac{1}{2}$–1 in. long which contain the spores. The stem appears to be jointed, each joint fitting into the other and covered with a sheath, bearing teeth which are black-pointed. This fern ally grows in moist vlei-land and marshy ground, near streams, local but widely distributed—High Veld, Bushveld, Low Veld, also in the Transvaal Drakensberg.

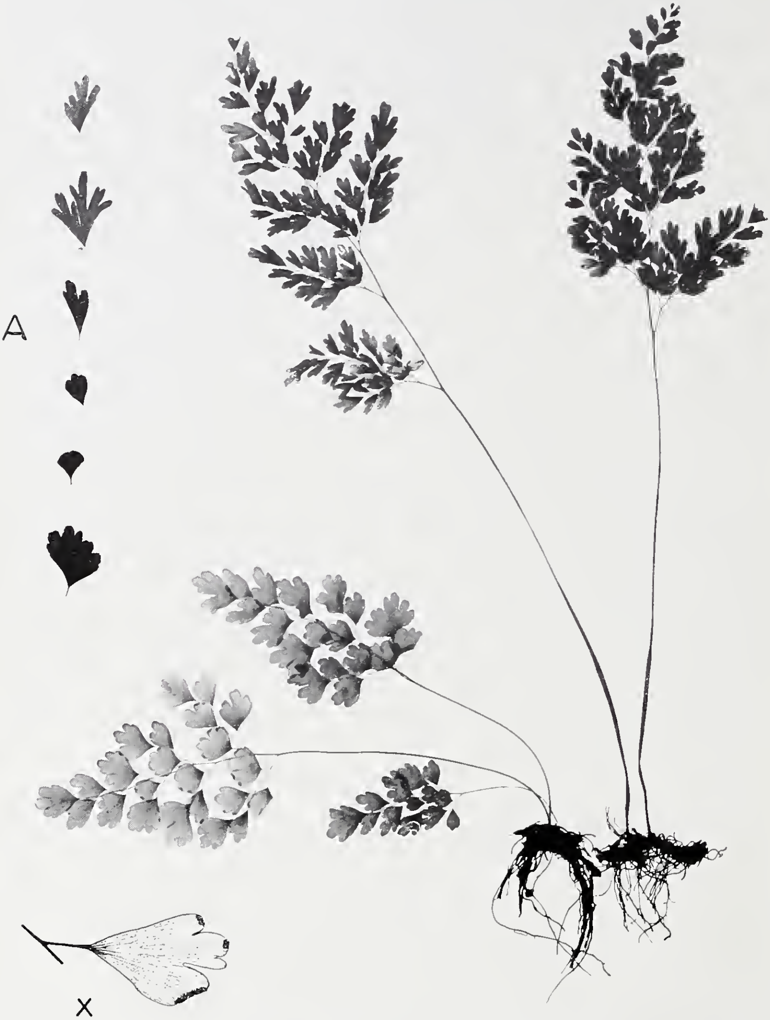

Fig. 13.—Adiantum capillus-veneris—Maidenhair fern.

A showing variation in outline of pinnules which occur in the same species. X—enlargement of pinnule.

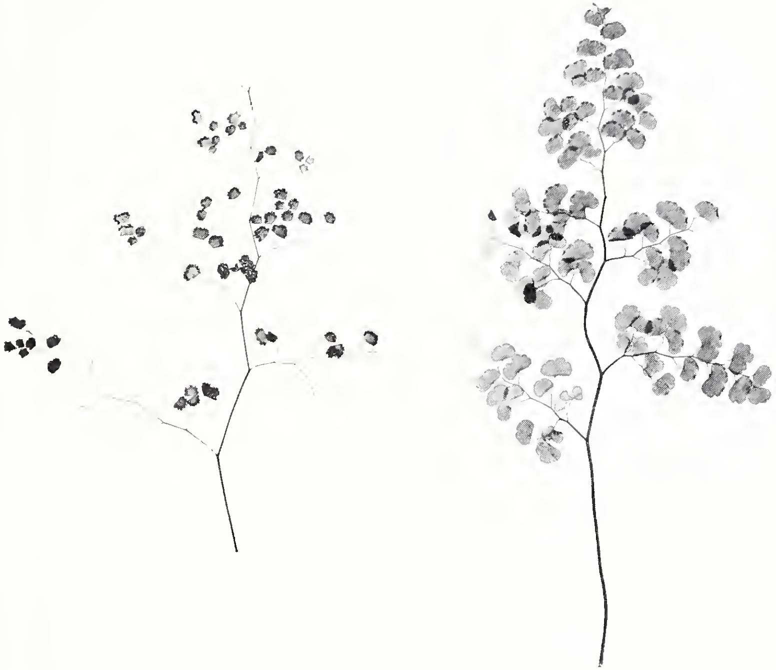

Fig. 14.—Adiantum thalictroides.

A species of maidenhair fern characterised by the pinnules dropping off when old, thus giving a skeletal effect to the frond.

This plant is poisonous to live-stock, especially horses and mules and also cattle. It produces giddiness and a kind of intoxication and stupidity in animals that eat it; the effects last from a few days to a fortnight or more, during which time the animals fall off in condition, cannot work, and are liable to death from falling into dongas, dams, etc.; if no such accident happens they usually recover.

Osmunda regalis Linn.: Flowering Fern or Royal Fern. Young fronds clothed with yellowish woolly tomentum; mature fronds smooth, pale-green, herbaceous, two-pinnate, 2–4 ft. long; barren pinnae (the lower half of the frond) 3–6 pairs, having 6–10 pairs of rather irregular oblong pinnules, rounded at the apex, entire or minutely toothed at the edges, rounded or somewhat lobed at the base; fertile pinnae altogether different, found at the summit of the frond, pinnules usually entirely covered with capsules on the under surface but with the pinnules' edges incurved so that the entire surface appears clothed. This causes the fertile frond to resemble a branchlet thickly covered with clusters of minute flowers.

This plant also belongs to a fossil family.

This fern grows near mountain streams and damp places, often in full sunshine, widely distributed but not common. Distribution: Northern and Eastern Transvaal, High Veld, Transvaal Drakensberg.

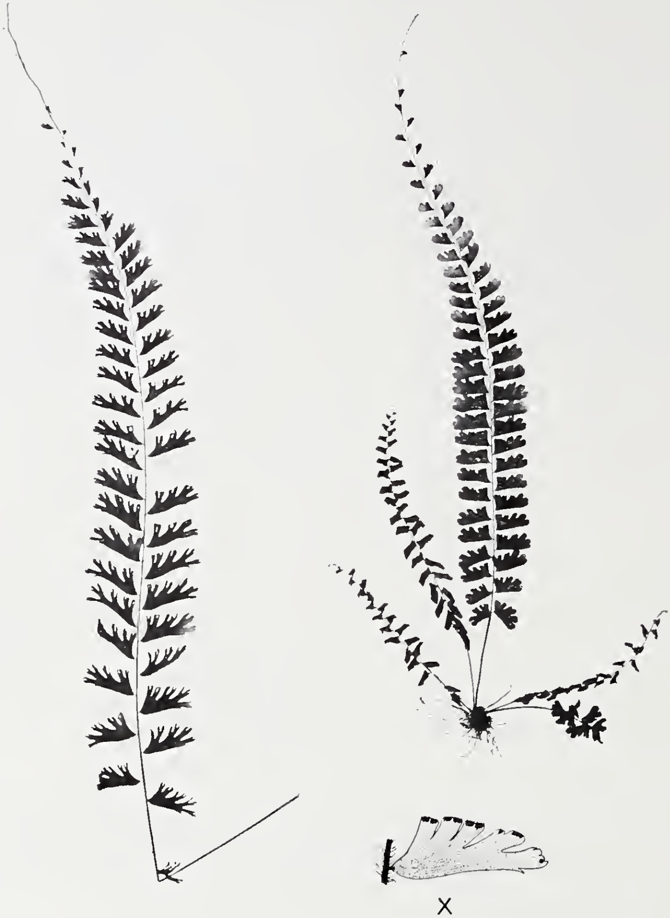

Fig. 15.—Adiantum incisum.

Also a species of maidenhair fern. The point of the rachis is a leafless extension, generally forming a bud at its apex which, when it reaches the ground, produces a new plant.

X—enlargement of pinna.

Todea barbara (L.) Moore: Tode's Fern. This large and splendid fern is often mistaken for a type of tree-fern. Crown sub-erect, forming large clumps often 3 ft. in height and diameter, thus resembling a stout stem; frond leathery, rigid 3–6 ft. long, 1–2 ft. broad; pinnae 2-pinnate or 2-pinnatifid, pinnules oblong blunt, toothed; sori mostly on lower pinnules, at first distinctly oval, afterwards confluent and covering the whole under surface. It is found in open wet places in forests, often growing beside streams. This is a rare fern found only in the Transvaal Drakensberg.

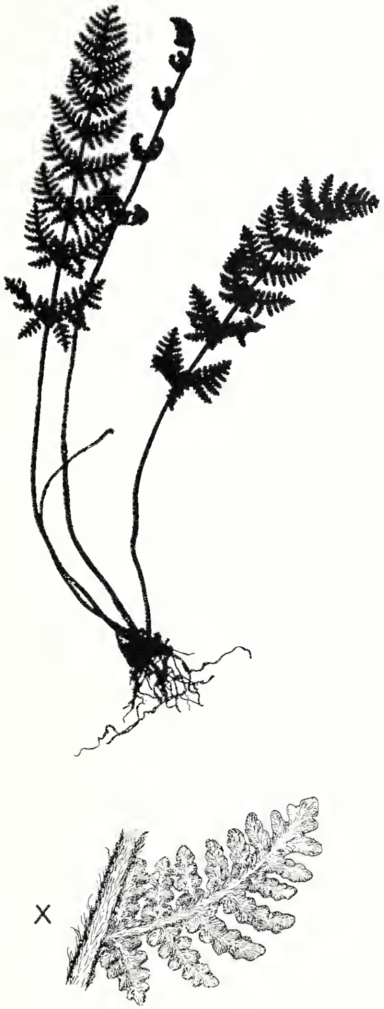

Fig. 16.—Notholaena eckloniana.
X—enlargement of pinna.

Mohria caffrorum (L.) Desv.: Scented Fern (Brand-bossies). Crown erect or sub-erect, paleaceous. Fronds numerous, 2-pinnate or 3-pinnatifid, firmly herbaceous, bluntly lanceolate, 6–18 in. long, 1–3 in. broad, with a paleaceous stipe 3–6 in. long. Pinnae distant below, closer above, with four to seven pairs of ovate pinnules, which are pinnatifid and toothed when barren, but almost entire and more confluent when fertile. Rachis and under surface more or less chaffy. The upper half of the frond is the part which becomes fertile, and as the edges turn in over the capsules, it becomes more rounded and looks different. It is strongly fragrant when bruised, and the dry fronds are pulverised, mixed with fat and made into a cooling ointment for burns and scalds.

The size and scaliness of the plant vary exceedingly. Forest-grown specimens have fronds sometimes 2 ft. long, 4 in. broad, and almost destitute of scales; and there is every gradation from this down to the dwarf rock-grown specimens with fronds 3 in. long, $\frac{3}{4}$ in. broad, and densely covered with reddish scales. It is found growing in damp, shady places on the outskirts of forests, on mountain slopes and among rocks. Distribution: Cosmopolitan.

Cyathea dregei Kunze: Common Tree-fern. Stem erect and stout, tree-like, generally 6–7 ft. high, but often 10 ft. and sometimes 15 ft. in height. Fronds 3–5 ft. long, 1–2 ft. broad, arranged in a crown at the top of the stem, more or less arching, and with the ends of the fronds turning upwards. The crown is densely set with narrow, spear-shaped, shining brown scales. Fronds are usually 3-pinnate, dark green above, lighter below; base of the stipe is set with stout soft prickles which become harder and more apparent when the frond matures; rachis and under side of the pinnules are more or less densely covered with brown tomentum (matted woolly hairs); pinnae 12–20 pairs, pointed; pinnules lanceolate, widest at the base, cut to or near to the rachis into segments which are bluntly pointed and either entire or toothed: sori 1–3 pairs at the base of each segment, arranged in involucres.

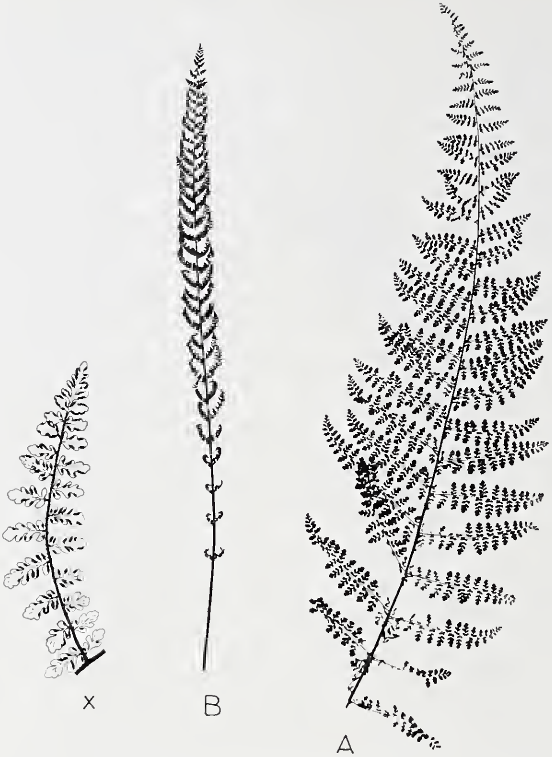

FIG. 17.—Cheilanthes hirta.

Two forms of the species. Form A grows in shady places; form B is generally found growing on hard, rocky, exposed ground.

X—enlargement of pinna.

This splendid tree fern sometimes grows on exposed and bare hill-sides but more often near springs or streams at the edges of mountain bush. It is also found in shady mountain kloofs; the stem is then longer and more slender and the fronds tend to have much less tomentum. Distribution: Magaliesberg, Rustenburg dist., Pietersburg dist., Houtbosberg, Waterberg dist., Lydenburg, Mariepskop, Barberton Mountains, Belfast, Woodbush.

Hypolepis sparsisora (Schrad.) Kuhn. This is a very large fern, growing in masses in wet sunny glades in the forest. It was an old miners' superstition, especially in the Low Veld, that where this fern grew, gold was to be found. Frond deltoid, branching, 2–5 ft. broad, 3–8 ft. long; when young, both surfaces bristling with spreading, jointed hairs, especially on the veins and rachis, but these fall off the stipe and rachis as the frond matures leaving rough raised points, while on the veins they become less noticeable; pinnules cut almost to the mid-rib into toothed segments bearing a sorus in each sinus. Distribution: Northern Transvaal in places such as Pietersburg dist., Haenertsburg, and in the Low Veld regions and eastern section of Transvaal Drakensberg.

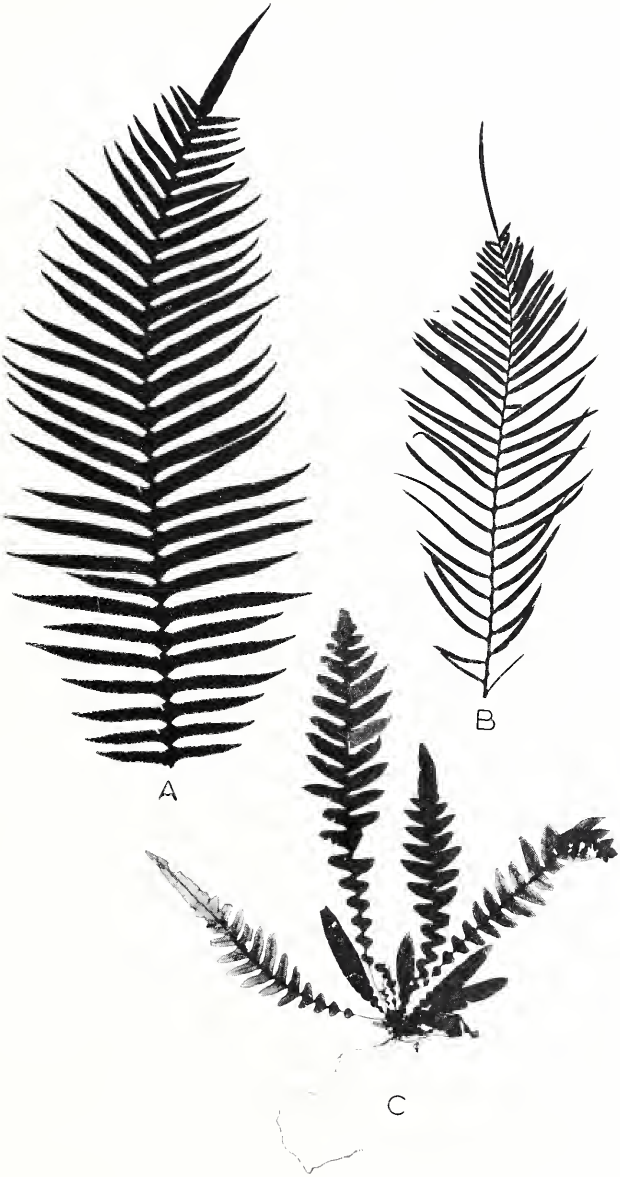

Fig. 18.—Blechnum attenuatum.

A sterile frond.
B fertile frond.
C young plant.

Actiniopteris radiata (Sw.) Link. This fern has the appearance of a small type of peculiar grass with palmate tops. Frond leathery, fan-shaped, 1–2 in. broad, divided to near the base into 4 or 6 divergent pinnules, which are again divided into 2–3 linear, spreading segments, 1 mm. broad, the apex toothed or sharply pointed; fertile segments; sori linear, marginal, continuous for the length of the segment. Distribution: Magaliesberg, Central Transvaal, Spelonken (Northern Transvaal), Low Veld, Limpopo, Soutpansberg.

Pellaea viridis (Forsk.) Prantl: Cliff-brakes. This is possibly the commonest fern to be found in South Africa growing both in the forests and on the veld, frequently without any shelter. It is a very variable plant with a wide range of cutting. Frond lanceolate or triangular generally 2-pinnate 1–3 ft. long on a shining brown wiry stipe which, when young, has scattered, soft, woolly scales towards the base; pinnae divided into 1–4 pairs of sessile pinnules which have very shallow rounded teeth; sori borne along the margins of the pinnules; lower surface of frond and pinna-rachises, densely hairy in some plants, glabrous in others; colour deep green. Distribution: cosmopolitan.

P. viridis (Forsk.) Prantl variety *glauca* Sim. There are two forms of this variety, often growing together, which in their extremes might well be set down as distinct species, but they run into one another. The smaller form is seldom more than four in. high, quite deltoid in shape and glaucous or grey-green in colour and with the small pinnules meeting above the rachis and cut into decurrent lobes. The larger form approaches the ordinary *P. viridis*, though is generally distinguishable. It is generally 6–12 in. high not so glaucous and with pinnules not so much lobed, but sometimes cut again into distinct oval segments.

This variety is found growing on top of nearly bare rock or among stones.

P. viridis. (Forsk.) Prantl variety *macrophylla* Sim. The frond is usually only once pinnate, with pinnae much larger and more pointed than the pinnules in the ordinary form. Sometimes the lowest pinnae are divided. This plant is not uncommon in forest.

Pellaea calomelanos (Sw.) Link. This plant has a wide distribution throughout the Transvaal and is a common fern found growing among stones or in the crevices or rocks, mostly with little or no shade and frequently under dry conditions. It is often found on the exposed rocky slopes of hills. Frond: 2- or 3-pinnate, deltoid, 6–8 in. long, 4–6 in. broad with a stout stipe slightly woolly below, but in the upper part and rachis quite naked, wiry and shining black; pinnules stalked, heart-shaped, halbert-shaped or three-lobed; sori running along the edges of the pinnule-margins. This fern is more rigid, thick and leathery in texture than any of the other *Pellaeas*, and when the frond is old, the pinnules drop off leaving the stalks adhering to the rachis.

Doryopteris concolor (Langsd. and Fisch.) Kuhn var. *kirkii* (Hook.) Fries: Geranium Fern. Frond more or less three-lobed and as broad as it is long (1–4 in.), varying from nearly round and entire to deeply cut, the frond then being bi-pinnatifid with the rachis having a wide, green margin. The barren fronds are small, round and hardly lobed; the fertile fronds are cut nearly to the rachis and the pinnae again are deeply cut into pointed lobed pinnules. The mid-rib and main veins are black and shining, and the sori are continuous all along the margin. This fern is found growing on dry banks in bush and is localised more or less in the Magaliesberg range, the Eastern Transvaal section of the Drakensberg and the mountains in Northern Transvaal.

Notholaena eckloniana Kzc. Frond narrow, 2–8 in. long, rather leathery, 3-pinnatifid with a stout woolly or scaly stipe; pinnae 8–15 opposite pairs, the lower ones largest; lower surface of frond thickly covered with short tomentum, at first white, afterwards rufous brown; sori marginal. This fern is endemic in South Africa and is found growing on or under dry stones, fully exposed to the sun. Distribution: Eastern Transvaal section of the Drakensberg, Magaliesberg, High Veld, Witwatersrand, Northern Transvaal.

Cheilanthes hirta Sw. This fern is found on hot, dry, rocky koppies under trees or between stones. It is common in the karroid sections of the High Veld, Magaliesberg and in the Transvaal Drakensberg, and is one of the most frequent and widely distributed ferns in this Province. Frond 3-pinnatifid, lanceolate, 6–18 in. long. 1–5 in. broad, set on a dark-brown stipe more or less scaly at the base and, like the rachis and veins, thickly set with soft, spreading white hairs; frond also abundantly set with hairs, especially on the upper surface; pinnules widely ovate, flat, cut half-way or more into three pairs of rounded or slightly lobed segments; sori marginal, not continuous, but separated.

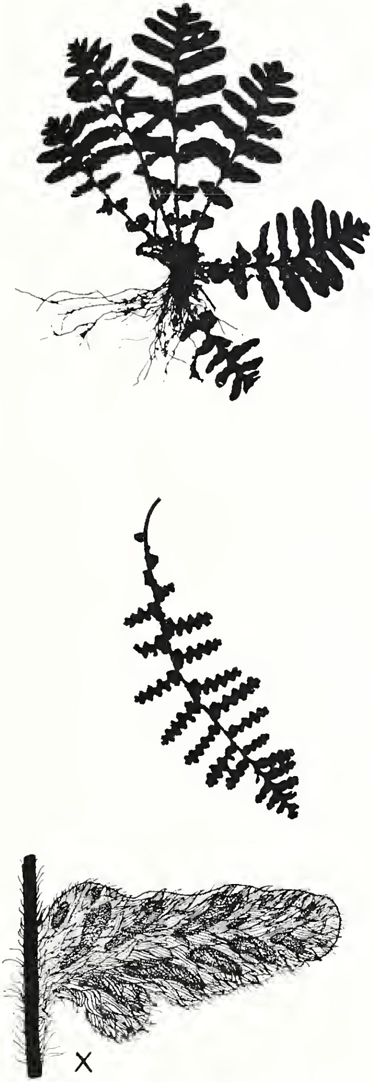

FIG. 19.—Ceterach cordatum.

Two forms of the same species.
X—enlargement of pinna.

Blechnum attenuatum (Sw.) Mett. A lovely fern which is often found growing in clumps of four or five crowns together, each with 12–20 fronds. The crown is set with narrow brown scales, making a tufted mass. The plant produces separate barren and fertile fronds. Frond simply pinnate,

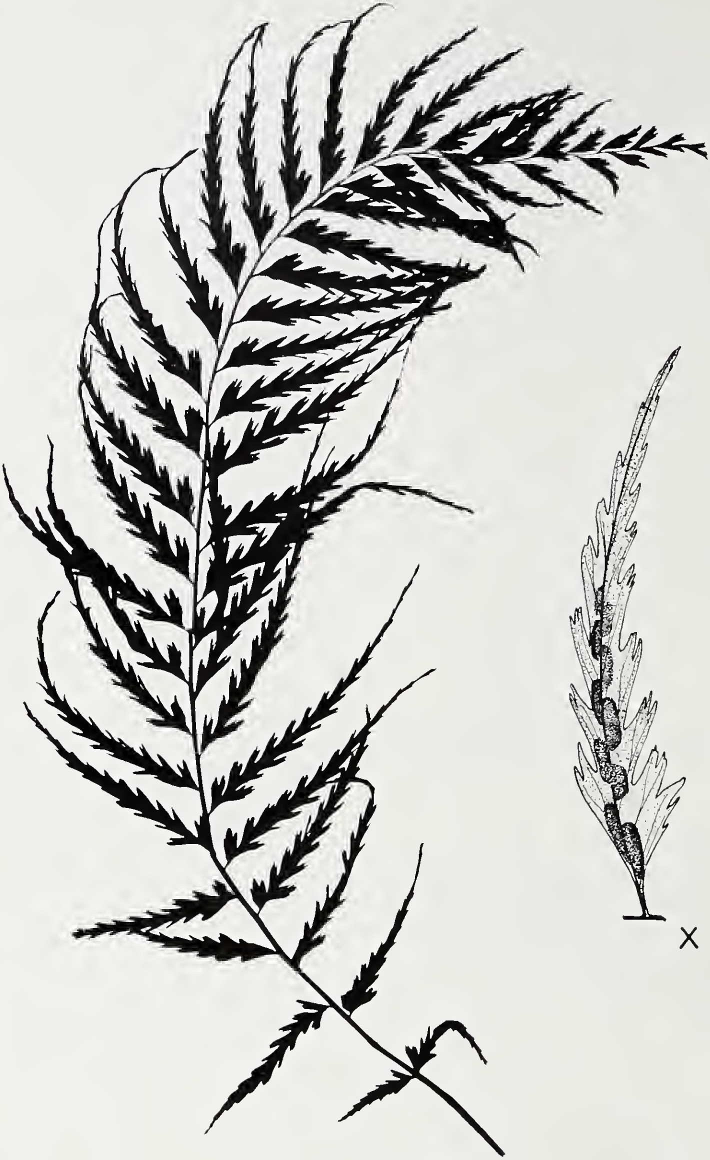

Fig. 20.—Asplenium friesiorum.
X—enlargement of pinna.

3–5 ft. long, 8–12 in. broad at the middle, tapering at both ends. Barren pinnae alternate, meeting at the base, the lower pinnae being very much reduced. The whole impression of the frond has that of a zig-zag effect. Young barren fronds are sometimes green but fairly often bright pink in colour. The fertile pinnae are separate, linear, narrower; the sori covering the whole of the under surface.

This species grows in deep, wet, shady ravines and around waterfalls in the forest; often in running water. Distribution: Found throughout the Transvaal.

Ceterach cordatum (Thunb.) Desv: Scaly Fern. This is a hardy little fern and varies a great deal depending on the conditions in which it grows. Specimens growing in the crevices of rocks are about 3 in. long or less, leathery in texture and densely scaly on the under surface; if growing under trees or bushes, it becomes 6–9 in. long, texture thinly membranaceous and with few scales. It curls up when dry and unfolds again when damp. Frond, pinnatifid, pinnate or 2-pinnatifid; pinnae cut into rounded toothed lobes which continue for some way down the stem; sori oblong, linear but rather difficult to detect owing to the dense covering of scales. Distribution: found

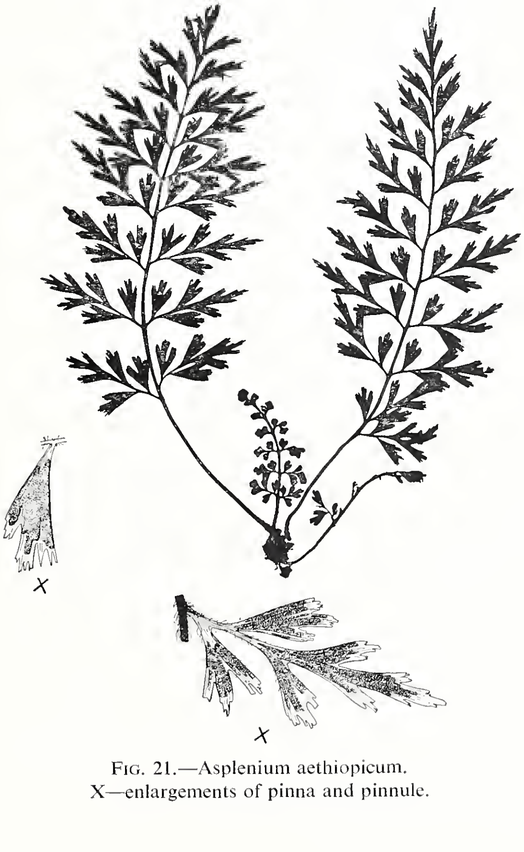

Fig. 21.—Asplenium aethiopicum.
X—enlargements of pinna and pinnule.

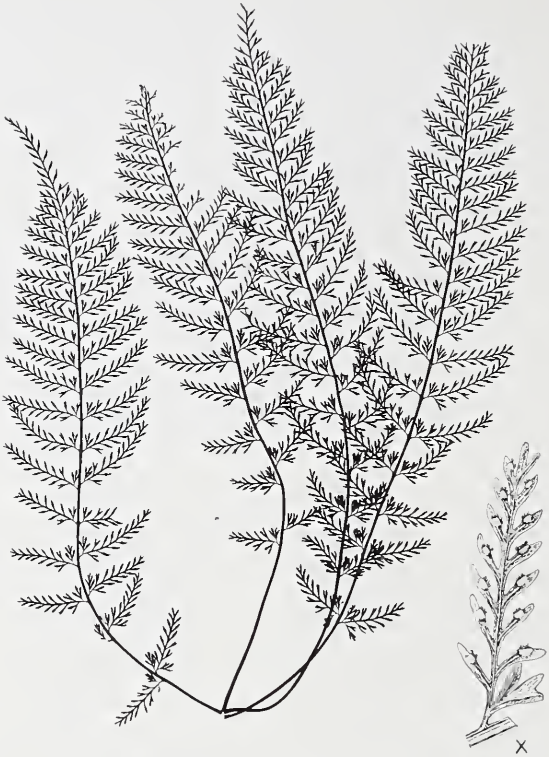

Fig. 22.—Asplenium rutaefolium.
X—enlargement of pinna.

in most parts of Transvaal, but especially in the High Veld and Bushveld regions and as far west as Zeerust.

Asplenium friesiorum C. Chr. This fern is a very beautiful one but fairly rare. It is found in the mountains among the crags and in montane forests, frequently under the drip of water. The frond is 2 ft. long, 6–8 in. broad; pinnae 15–20 pairs tapering to long attenuated points, unequally wedge-shaped at the base and cut into more or less oblong sharply-toothed lobes; sori united into two lines along the length of the pinnae. Distribution: Low Veld, Mariepskop, Graskop.

Asplenium aethiopicum (Burm.) Bech.: Spleenwort. This fern is a very variable plant and occurs in several forms, some much more divided or cut than others. Frond 2-pinnate, 2–4 in. broad and 1–1½ ft. long, with about 12 pairs of pinnae; pinnae cut into four or seven wedge-shaped pinnules all with the upper margin sharply toothed; sori in lines along the centre of the pinnules; stipe and rachis nearly black, set with rusty-brown scales, increasing in size downward. This plant is rather common in the Transvaal, being found throughout the Province.

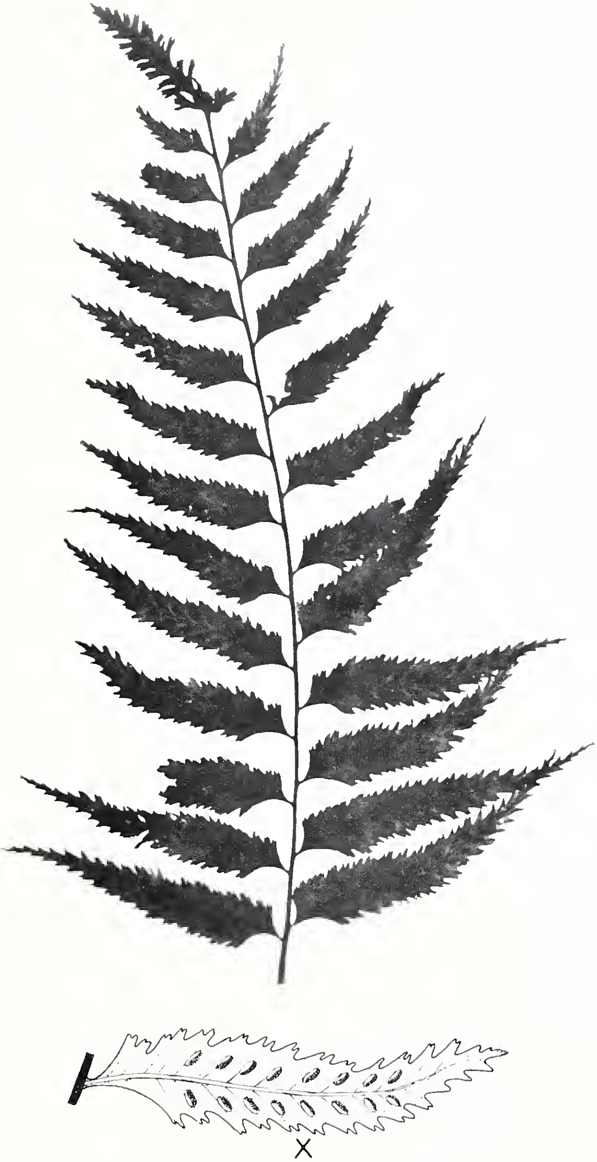

Fig. 23.—Asplenium anisophyllum.

This species is charaeterised by the pinna being deeply toothed, the teeth mostly in pairs and in some fronds the pinnae have a long, narrow point. The frond frequently bears a bud at the base of the topmost pinna. This fern grows often among stones under trees, in damp places.

X—enlargement of pinna.

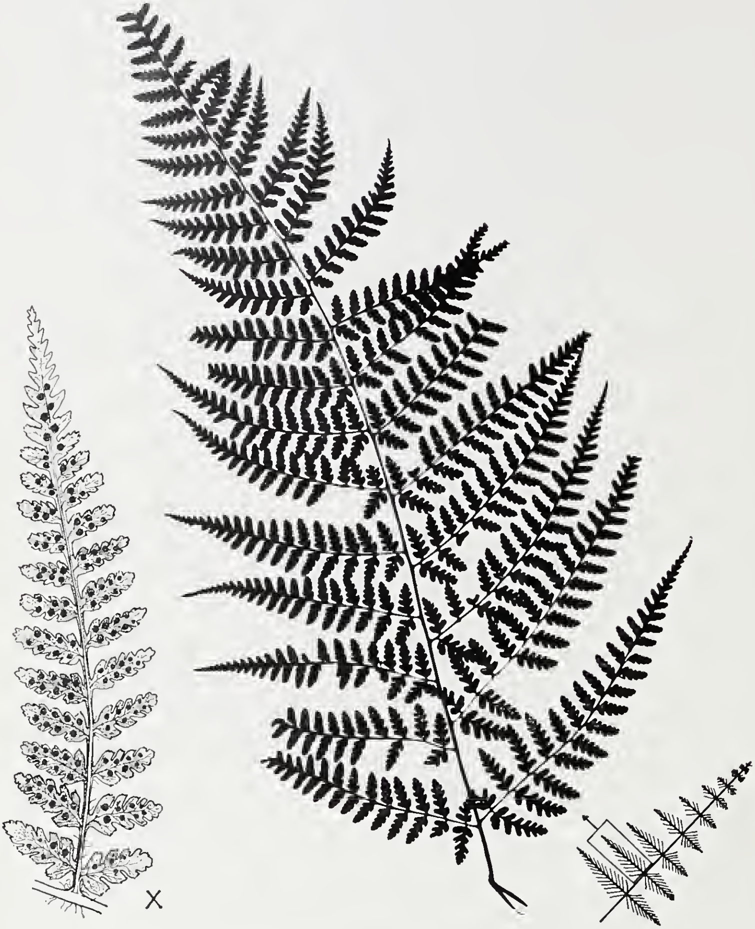

Fig. 24.—Dryopteris pentherii.
X—enlargement of pinna.

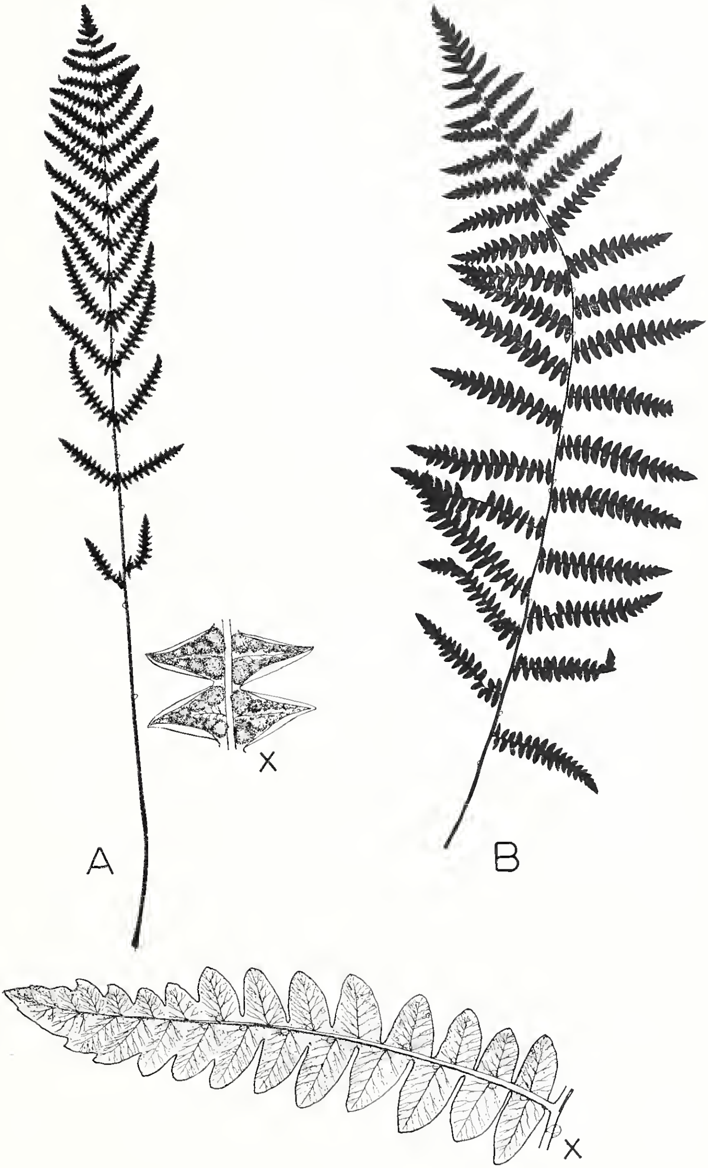

Fig. 25.—Thelypteris palustris var. squamigera.

A—fertile frond. X—enlargement of fertile pinnules.
B—sterile frond. X—enlargement of sterile pinnules.

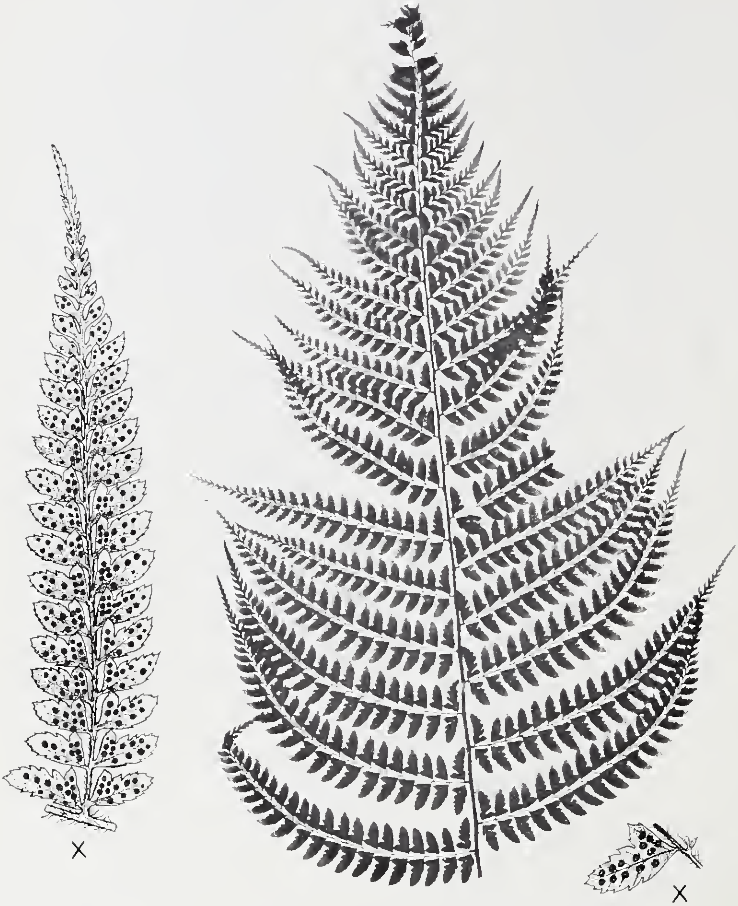

FIG. 26.—Polystichum ammifolium.

This fern grows as scattered single plants, mostly in forests and has softly herbaceous drooping or spreading fronds. The stipe is stout and covered with large, pointed, reddish-brown scales. The same plant in shade or sun or growing among rocks shows many variations which unfortunately can be confused with another species (*P. lucidum*) which is a much more rigid plant growing in masses on open hillsides.

X—enlargements of pinna and pinnule.

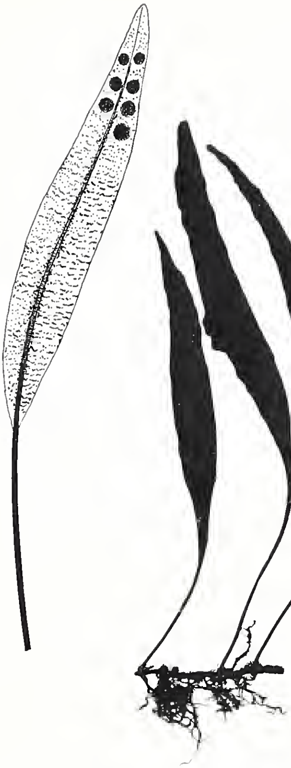

FIG. 27.—Pleopeltis lanceolata.

Asplenium rutaefolium (Berg.) Kunze: Carrot Fern. This plant is fairly common in mountainous regions, occurring mainly in Northern Transvaal and Eastern Transvaal. It rather resembles the feathery tops of carrots—hence its common name. The frond varies from 6 in. to 1½ ft. long and 2–6 in. broad. All the pinnules or segments as well as the pinna-rachis consist of only a thickly margined vein.

The sori in this species are formed in a rather unusual way. They are not borne on the surface of the frond but are embedded in cup-like structures in the margins. This is a forest fern, growing frequently on trees and stumps, sometimes among rocks.

Dryopteris pentherii (Krass.) C. Chr. This is one of the commonest forest ferns. Rhizome densely covered with large, pointed, yellowish-brown scales. The frond is deltoid, branched, herbaceous, 4-pinnatifid, 1–4 ft. long, 1–3 ft. broad, with a stout, rounded stipe 1–2 ft. long which is abundantly paleaceous, with scattered large scales upward; pinnae widest at the base; the lower ones much the largest, cut into separate, ovate, sharply toothed pinnules; the smaller pinnae cut only half-way to the mid-rib; pinnules

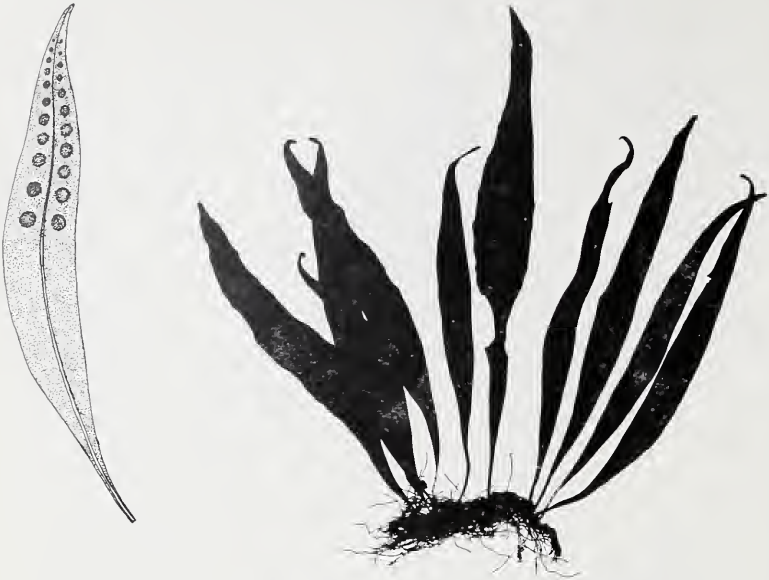

Fig. 28.—Pleopeltis schraderi.

P. excavata (Fig. 29) differs from *P. schraderi* (Fig. 28) in having longer fronds of a much thinner texture with the veins unobscured. Both species differ from *P. lanceolata* (Fig. 27) in not bearing scales on the under surface of the fronds.

and segments all rounded with several sharp-pointed teeth; sori numerous, rather large. Distribution: Mac-mac Falls, Lydenburg, Barberton, Letaba, Houtbos, Belfast; fairly cosmopolitan.

Thelpyteris palustris Schott var. *squamigera* (Schlecht.) Tardieu Blot: Wood-fern. This fern is found in damp marshy places, in swamps or "vleis" or along the banks of rivers creeping among the pebbles and boulders at the river's edge. Owing to its long, slender, underground rhizomes, this fern takes possession when it gets a hold and forms a mass of fronds several yards wide. The frond is herbaceous, 2-pinnatifid, lanceolate, 1–2 ft. long, 3–6 in. broad, with a slender naked stipe often a foot long. Rachis and mid-rib scaly, with short, wide, whitish scales. Pinnae are opposite one another, sessile, divided to near the mid-rib into rounded, entire (i.e. not toothed) rather unequal pinnules. In the fertile frond the margin is recurved so that the pinnules look narrower and more triangular. The veinlets are free, mainly forked and the sori small, almost marginal. Localities: Middelburg, Rustenburg, Bronkhorstspruit, Barberton, Pilgrim's Rest, Krugersdorp, Bokfontein, Magaliesberg, Eastern Drakensberg, High Veld region, Witwatersrand; common.

Pleopeltis lanceolata (L.) Kaulf. This is an epiphytal fern growing on trees or clinging to rocks. The rhizome is very long, exposed, creeping, slightly branched, clothed in dark scales; frond simple, leathery, entire,

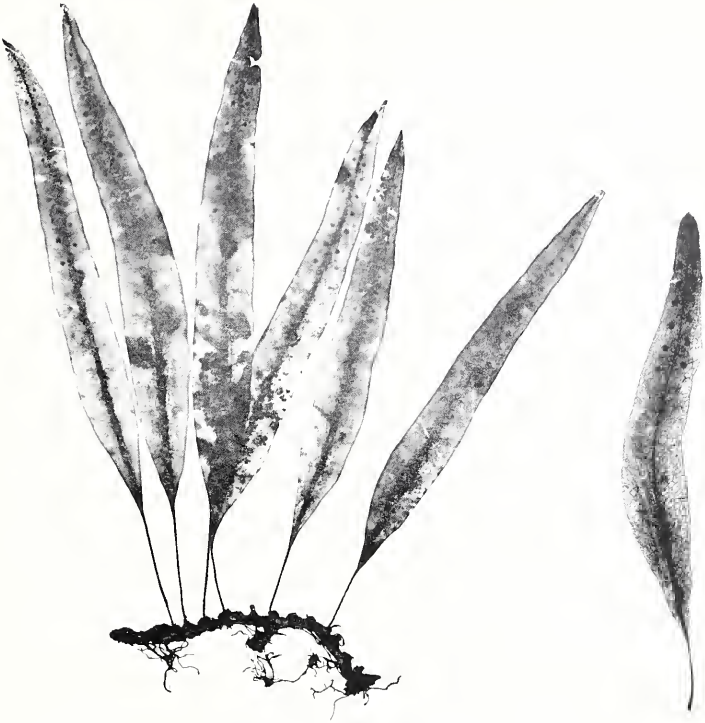

Fig. 29.—Pleopeltis excavata.

tapering to both ends, 4–12 in. long, ½-in. broad with a paleaceous, or sometimes naked, wiry stipe; upper surface of the frond often glabrous but the under side scaly with minute scales fixed to the frond by the centres which are black but lighter towards the edge; sori round, large, mostly in the upper part of the frond and sunk into it in a row on each side of the mid-rib.

Forest-grown plants are much larger and more vigorous than rock-grown plants exposed to sunshine, where the fronds are only 2–3 in. long and densely clothed in scales. Localities: Magaliesberg, Witwatersrand, High Veld and in the mist-belt forests of Transvaal Drakensberg; a fairly wide distribution throughout the province.

CHECK-LIST OF THE FERNS AND FERN ALLIES OF THE TRANSVAAL

PSILOTACEAE

- Psilotum nudum (L.) Griseb.

LYCOPODIACEAE

- Lycopodium
  - gnidioides L. fil.
  - dacrydioides Bak.
  - verticillatum L. fil.
  - ophioglossoides Lam.
  - clavatum L. (Fig. 1)
  - cernuum L.
  - sarcocaulon A.Br. and Welw.

SELAGINELLACEAE

- Selaginella
  - caffrorum (Mild.) Hieron.
  - dregei (Presl) Hieron. (Fig. 2)
  - mittenii Bak.
  - kraussiana (Kze.) A.Br.

EQUISETACEAE

- Equisetum ramosissimum Desf. (Fig. 4)

MARATTIACEAE

- Marattia fraxinea Sm. var. salicifolia (Schrad.) C.Chr. (Fig. 3)

OPHIOGLOSSACEAE

- Ophioglossum
  - gomezianum Welw.
  - polyphyllum A.Br. ex Seub.
  - reticulatum L.

OSMUNDACEAE

- Osmunda regalis L. (Fig. 5)
- Todea barbara (L.) Moore

SCHIZAEACEAE

- Schizaea
  - pectinata (L.) Sw.
  - tenella Kaulf.
- Anemia
  - dregeana Kunze
  - simii Tardieu Blot
- Mohria caffrorum (L.) Desv. (Fig. 6)

MARSILIACEAE

- Marsilia
  - macrocarpa (D.C.) Presl
  - trichocarpa Bremek.
  - ephippiocarpa Alston

GLEICHENIACEAE

- Gleichenia
  - umbraculifera Kze.
  - polypodioides (L.) Sm.
- Dicranopteris linearis (Burm.) Underw.

HYMENOPHYLLACEAE

- Trichomanes
  - melanotrichum Schlecht.
  - montanum Hook.
  - rigidum Sw.
  - borbonicum v.d. B.
- Hymenophyllum
  - capillare Desv.
  - capense Schrad.
  - tunbridgense (L.) Sm.

CYATHEACEAE

- Cyathea
  - capensis (L. fil.) Smith
  - dregei Kunze (Fig. 7)

POLYPODIACEAE

- Microlepia speluncae (L.) Moore
- Hypolepis sparsisora (Schrad.) Kuhn (Fig. 8)
- Davallia chaerophylloides (Poir.) Steud.
- Oleandra distenta Kunze
- Pteridium aquilinum (L.) Kuhn
- Blotiella glabra (Bory) Tryon
- Histiopteris incisa (Thunb.) J. Sm.
- Pteris
  - vittata L.
  - cretica L.
  - dentata Forsk. subsp. flabellata (Thunb.) Runemark
  - catoptera Kze.
- Actiniopteris radiata (Sw.) Link (Fig. 9)
- Pityrogramma
  - argentea (Willd.) Domin
  - argentea var. aurea (Desv.) Domin
- Adiantum
  - incisum Forsk. (Fig. 15)
  - capillus-veneris L. (Fig. 13)
  - thalictroides Willd. (Fig. 14)
- Cheilanthes
  - hirta Sw. (Fig. 17)
  - multifida Sw.
  - bergiana Schlecht. ex Kunze
- Notholaena
  - eckloniana Kunze (Fig. 16)
  - inaequalis Kunze
- Pellaea
  - dura (Willd.) Baker
  - goudotii (Kze.) C.Chr.
  - quadripinnata (Forsk.) Prantl
  - involuta Bak.
  - viridis (Forsk.) Prantl (Fig. 10)
    - var. macrophylla Sim
    - var. glauca Sim
  - boivinii Hook.
  - calomelanos (Sw.) Link (Fig. 11)
- Doryopteris concolor (Langsd. and Fisch.) Kuhn var. kirkii (Hook.) Fries (Fig. 12)

- Vittaria
  - isoetifolia Bory
- Blechnum
  - inflexum (Kze.) Kuhn
  - attenuatum (Sw.) Mett. (Fig. 18)
  - tabulare (Thunb.) Kuhn
  - capense (L.) Schlecht.
  - punctulatum Sw.
    - var. atherstonei (Pap. & Raw.) Sim
  - australe L.
- Asplenium
  - stoloniferum Bory
  - platyneuron (L.) Oakes
  - monanthes L.
  - lunulatum Sw.
  - quintasii Gandozer
  - erectum Bory
  - lobatum Pappe & Rawson
  - inaequilaterale Willd.
  - protensum Schrad.
  - varians Wall. ex Hook. & Grev.
  - anisophyllum Kunze (Fig. 23)
  - boltonii Hook.
  - gemmiferum Schrad.
  - flexuosum Schrad.
  - friesiorum C.Chr. (Fig. 20)
  - adiantum-nigrum L.
  - splendens Kunze
  - aethiopicum (Burm.) Bech. Fig. 21)
  - rutaefolium (Berg.) Kunze (Fig. 22)
  - sandersonii Hook.
  - theciferum (HBK) Mett. var. concinna (Schrad.) C.Chr.
- Ceterach cordatum (Thunb.) Desv. (Fig. 19)
- Athyrium
  - arborescens (Bory) Sw.
  - scandicinum (Willd.) Presl
  - schimperii Moug.
- Cystopteris fragilis (L.) Bernh.
- Woodsia burgessiana Gerr.
- Dryopteris
  - inaequalis (Schlecht.) O.Ktze.
  - pentherii (Krass.) C.Chr. (Fig. 24)
  - athamantica (Kze.) O.Ktze.
  - squamiseta (Hook.) O.Ktze.
- Hypdematium crenatum (Forsk.) Kuhn
- Thelypteris
  - bergiana (Schlecht.) Ching
  - palustris Schott. var. squamigera (Schlecht.) Tardieu Blot (Fig. 25)
  - dentata (Forsk.) Allan
  - patens (Fée) Copel.
  - pozoi (Lagasca) Morton
- Ampelopteris prolifera (Retz.) Copel.
- Ctenitis lanuginosa (Willd.) Copel.
- Rumohra adintiformis (Forst.) Ching
- Polystichum
  - lucidum (Burm.) Bech.
  - luctuosum Moore
  - macleaii (Bak.) Diels
- Cyrtomium
  - caryotideum (Wall.) Presl var. micropteron (Kze.) C.Chr.
- Didymochlaena truncatula (Sw.) J. Sm.
- Tectaria gemmifera (Fée) Alston
- Pleopeltis
  - lanceolata (L.) Kaulf. (Fig. 27)
  - schraderi (Mett.) Tardieu Blot (Fig. 28)
  - excavata (Bory ex Willd.) Moore (Fig. 29)
- Loxogramme lanceolatum (Sw.) Presl
- Polyopdium ecklonii Kunze
- Phymatodes scolopendria (Burm.) Ching
- Microgramma lycopodioides (Willd.) Copel.
- Elaphoglossum
  - conforme (Sw.) Schott.
  - latifolium (Sw.) Moore
  - aubertii (Desv.) Moore
- Pyrrosia schimperiana (Mett.) Alston

Addenda:

Dryopteris foliosa C. Chr.
Cyclosorus gongylodes (Schk.) Link
Polystichum ammofilium (Poir.) C. Chr.

PUBLICATIONS

The following is a list of publications that have appeared in scientific journals or have been contributed to conferences. Most of them were written by scientists of the Nature Conservation Branch, but some are contributions by scientists who collaborated with them:

1. du Plessis, S. S. (1950). Notes on the Summer Hatchings of Imported Trout Ova and Rearing of Trout at the Provincial Fisheries Institute, Lydenburg, Transvaal. Minutes Inl. Fish. Conference, Pietermaritzburg, p. 20.
2. du Plessis, S. S. (1950). The Importation of Eastern Brook Trout into the Transvaal in 1950. Min. Inl. Fish. Conference, p. 25.
3. du Plessis, S. S. (1952). The culture of *Barbus aeneus*. 1st Symposium on African Hydrobiology and Inland Fisheries, Entebbe, p. 86.
4. du Plessis, S. S. (1952). Fish Diseases in Transvaal. 1st Symposium on African Hydrobiology and Inland Fisheries, Entebbe, p. 128.
5. du Plessis, S. S. (1955). The Control of *Serranochromis thumbergi* in Merensky Dam. Proc. of the Third Inter-Provincial Inland Fisheries Technical Conference, p. 97.
6. du Plessis, S. S. (1956). The Status of *Serranochromis thumbergi* in Transvaal. 2nd Symposium on African Hydrobiology and Inland Fisheries, Brazzaville, p. 85.
7. du Plessis, S. S. (1956). The White-breasted Cormorant, *Phalacrocorax lucidus* in Captivity. 2nd Symposium on African Hydrobiology and Inland Fisheries, Brazzaville, p. 267.
8. du Plessis, S. S. (1956). Some adaptations of the Genera *Barbus* and *Varicorhinus* to Feeding habits. 2nd Symposium on African Hydrobiology and Inland Fisheries, Brazzaville, p. 85.
9. le Roux, P. J. (1956). Feeding Habits of the Young of four Species of Tilapia. S.A. Journ. of Science 53: 33–37.
10. du Plessis, S. S. (1957). Growth and daily Food Intake of the White-breasted Cormorant. The Ostrich 28: 197–201.
11. Lombard, G. L. (1957). Report on the Lowveld Fisheries Research Station at Marble Hall, Transvaal. C. S. A. Publication No. 25, 2nd Symposium on African Hydrobiology and Inland Fisheries, Brazzaville, 1956.
12. de Meillon, B, Frank, G. H., and Allanson, B. R. (1958). Some Aspects of Snail Ecology in South Africa. A Preliminary Report. Bull. Wld. Hlth. Org. 18: 771–783.
13. Cholnoky, B. J. (1958). Hydrobiologische Untersuchungen in Transvaal II. Selbstreinigung im Jukskei—Crocodile Fluszsystem. Hydrobiogia 11: 205–226.
14. Groenewald, A. A. van J. (1958). A Revision of the Genera *Barbus* and *Varicorhinus* (*Pisces: Cyprinidae*) in Transvaal. Annals of the Transvaal Museum 23: 263–330.
15. Shewell, A. L. (1959). The Waterfowl of Barberspan. The Ostrich, Supp. No. 3.
16. Van der Merwe, N. J. and Winterbottom, J. M. (1959). A List of the Birds of the S.A. Lombard Nature Reserve, Bloemhof District. The Ostrich 30: 73–76.
17. Lombard, G. L. (1960). A Preliminary Survey of the Occurrence of Trematodes in Fish and Aquatic Birds. C.S.A. Publication No. 63, 3rd Symposium on Hydrobiology and Inland Fisheries, Lusaka.
18. Lombard, G. L. (1960). Four Years of Experimental Culture of *Tilapia mossambica* in the Transvaal. C.S.A. Publication No. 63, 3rd Symposium on Hydrobiology and Inland Fisheries, Lusaka.
19. Winterbottom, J. M. and van der Merwe, N. J. (1960). Duck Counts at the S.A. Lombard Nature Reserve, Transvaal. The Ostrich 31: 131–135.
20. Keller, P. (1960). Bacteriological Aspects of Pollution in the Jukskei-Crocodile River System in the Transvaal, South Africa. Hydrobiologia 14: 205–254.
21. Allanson, B. R. and Gieskes, J. M. T. M. (1961). Ecology of Polluted Inland Waters in the Transvaal. Part I by B. R. Allanson: the Physical, Chemical and Biological conditions in the Jukskei-Crocodile River System. Part 2 by B. R. Allanson and J. M. T. M. Gieskes: An introduction to the Limnology of Hartbeestpoort Dam with special Reference to the Effect of Industrial and Domestic Pollution. Hydrobiologia 18: 1–94.

22. Allanson, B. R. and Kerrich, J. E. (1961). A Statistical Method for estimating the Number of Animals found in Field Samples drawn from Polluted Rivers. Verh. Internat. Verein. Limnol. 14: 491–494.
23. Venter, G. E. (1961). A new Ephemeropteran Record in South Africa. Hydrobiologia 18: 327–331.
24. Farkas, T. (1961). Notes on the Behaviour of the Mocking Chat. *Thamnolaea c. cinnamomeiventris* (Lafr.) in Western Transvaal. The Ostrich 32: 122–127.
25. le Roux, P. J. (1961). Growth of *Tilapia mossambica* Peters in some Transvaal Impoundments. Hydrobiologia 18: 165–175.
26. Farkas, T. (1962). Zur Biologie und Ethologie der südafrikanischen Arten der Gattung *Monticola* (Boie). I Teil: *Monticola brevipes*. Die Vogelwelt 83: 97–115.
27. Farkas, T. (1962). Zur Biologie und Ethologie der südafrikanischen Arten der Gattung *Monticola* (Boie). Teil II, *Monticola rupestris* L. Die Vogelwelt, 83: 161–173.
28. Farkas, T. (1962). Contribution to the Bird Fauna of Barberspan. The Ostrich, Supp. No. 4.
29. Farquharson, F. L. (1962). The Distribution of Cyprinids in South Africa. Ann. Cape Prov. Mus., II: 233–251.
30. Kettlitz W. K. (1962). The Distribution of some of the larger Game Mammals in. the Transvaal (excluding the Kruger National Park). Ann. Cape Prov. Mus., II: 118–137.
31. Farkas, T. (1963). Zur Biologie und Ethologie etc. Teil 3 *Monticola explorator* (Vieill). Die Vogelwelt, 84: 11–22.
32. Venter, G. E. Investigation into the Ecology of Polluted Waters in the Transvaal. Part 3. The Distribution and Ecology of the Freshwater Invertebrate Fauna in the Olifants River—Klipspruit System near Witbank, with particular Reference to the Effects of Acid Pollution. In the Press.
33. du Plessis, S. S. (1963). A revision of the Genus *Labeo* (*Pisces: Cyprinidae*) in the Transvaal, with a Description of a new Species. Annals of the Transvaal Museum, 24: 327–337.
34. du Plessis, S. S. The Limnology of the Ohrigstaddam in Relation to Trout Fishery (in the press).

The colour photo on the outside back cover page shows a White Rhino cow in the Loskop Dam Nature Reserve with a calf. This is the first of its kind born in Transvaal since 1896, the year in which the species became extinct in this Province.

Photo by Dick Wolff.

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Water-Lilies

FAUNA & FLORA

AN OFFICIAL PUBLICATION OF THE
TRANSVAAL PROVINCIAL ADMINISTRATION

The opinions expressed in this bulletin are not necessarily those of the Nature Conservation Branch nor of the Administration

Editor: Dr. R. BIGALKE
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ADMINISTRATION OF THE PROVINCE OF TRANSVAAL

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Some Mushrooms of the Transvaal

Miss B. A. Louwrens

Plant Protection Research Institute, Pretoria

MUSHROOMS are not plentiful in the Transvaal. It is a summer-rainfall area and the sudden changes of humidity and temperature are the opposite of ideal for the growth of fungi of any sort. Only during the rare, long, rainy spells do they appear in any great numbers, and if a dry period should follow, they all disappear as suddenly as they came. Under these adverse conditions it is amost impossible to make a complete and thorough study of any mushroom species found here. This is one of the reasons why our knowledge of the mushrooms of the Transvaal is so incomplete.

There are seventy-three genera of mushrooms in the fungus herbarium in Pretoria, and of fifty of these we have specimens which were collected in the Transvaal. However, several genera are only represented by one or two specimens, while of others again, like the genus *Lepiota* for instance, there are nearly a hundred specimens. One of the reasons for this is that *Lepiota* specimens dry quite easily while many others turn into a pulpy mess or, as in the case of many *Coprinus* specimens, liquefy into a black watery mess quite soon after they have been picked.

Of the mushrooms found in the Transvaal I have chosen to describe (with one exception) ten of the larger and more conspicuous species, six of which are good edible varieties, while four are poisonous.

GLOSSARY OF TERMS

cap or *pileus*: the expanded part of a mushroom supported by the stem and bearing the gills.

cup or *volva*: the cup-shaped structure at the base of the stem.

fungus: a flowerless plant that lacks chlorophyll and is nourished by mycelium which permeates the soil and other substances such as dead wood, living plants, etc. on which it grows. All fungi are therefore saprophytes or parasites. Reproduction is either vegetative by the mycelium directly or by spores which germinate and eventually give rise to more fruiting bodies.

gills or *lamellae*: the blade-like structures attached to the under side of the cap and radiating from the stem to the margin of the cap. These gills bear the spores.

hypha (plural *hyphae*): a single inconspicuous minute fungus thread.

mushroom: a fungus with a cap, gills and stem which is nourished by the mycelium which permeates substances manufactured by living plants on which it grows.

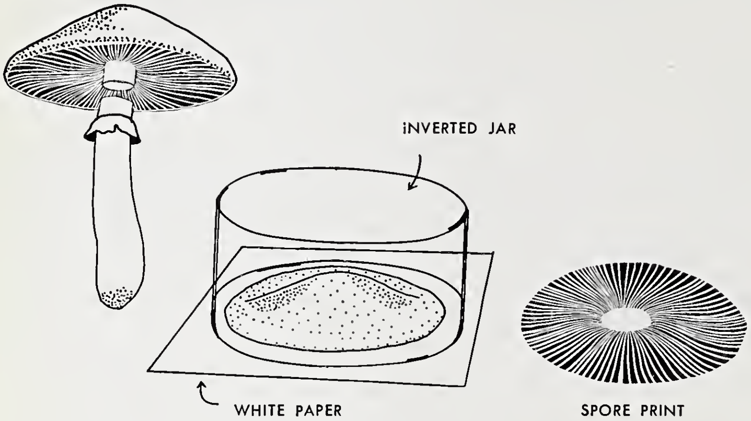
mycelium or *spawn*: a collection of hyphae which are interwoven and permeate the soil and humus. The vegetative portion of a mushroom, root-like in function.

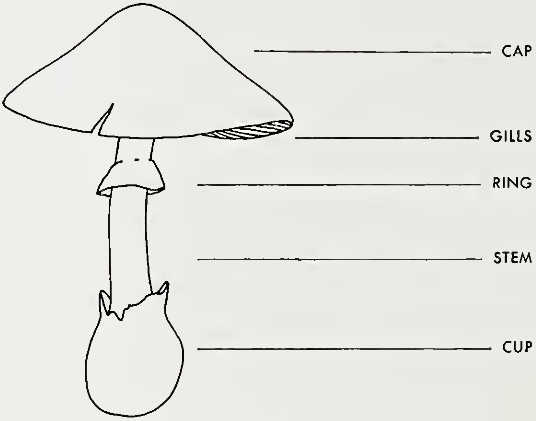
ring or *annulus*: a ring round the stem. It is the remains of the skin which originally connected the edge of the cap with the stem and which broke when the cap expanded.

spore print: in order to find out what the colour of the spores in mass of an unknown mushroom is, a spore print can be made. The stem of a freshly picked mushroom should be cut off just below the gills and the cap then placed, gills facing downwards, on a white piece of paper and covered with an inverted jar or dish of some sort to prevent the spores falling from the gills from being blown away. After a few hours the cap can be lifted and it will be seen that masses of spores will have dropped on the paper in the exact pattern of the gills from which they have fallen.

spores: the reproductive bodies of fungi, thus the "seeds" of fungi. They germinate and form the spawn.

striate: having minute furrows or lines.





EDIBLE

Agaricus campestris (= *Psalliota campestris*)

THE COMMON OR FIELD MUSHROOM

For specimens in this genus the name *Psalliota* has often been used, but under the International Code of Nomenclature the correct name is *Agaricus.*

CAP: 5-11 cm in diameter, spherical when very young because the outside edge of the cap is still connected to the stem by a veil which hides the gills, then expanding, breaking the veil in the process, and becoming hemispherical and finally almost flat; creamy-white, light grey or light beige, often tinged reddish-brown later on, smooth and rather shiny or quite scaly, the margin extending beyond the gills.

STEM: 2.5-8 cm long and up to 2 cm in diameter, white, firm, usually, but not always, of equal thickness with a white ring attached to the upper part. This ring is always present on young specimens, but is very slight and delicate and rubs off very easily and is seldom seen on older plants.

GILLS: at first very pale creamy-pink, then becoming a dirty brownish-pink and finally a dark chocolate-brown, crowded close together and not touching the stem.

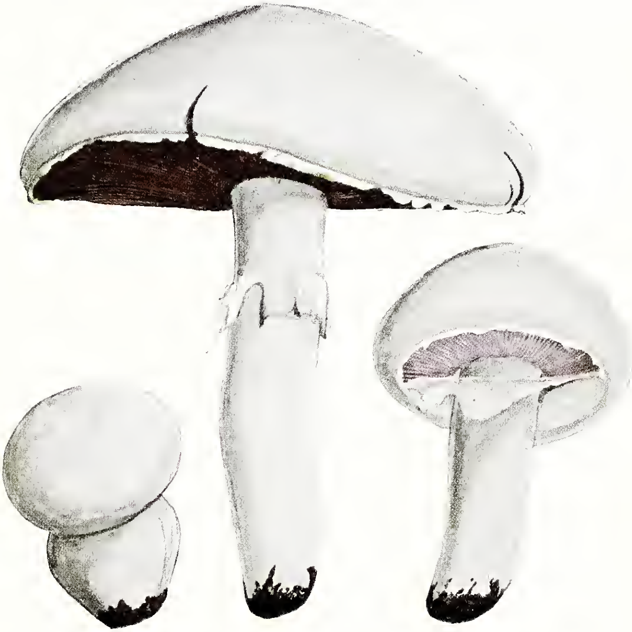
FLESH: thick, firm, white, but becoming tinged with brown when bruised or cut; odour and taste pleasant.

SPORE PRINT: chocolate-brown.

Agaricus campestris appears in summer after rain and is found on lawns, in open grassy places, on roadsides, and anywhere in the open veld where it is sunny and moist.

There are many varieties of this very common, wild, edible mushroom as well as of the Horse Mushroom, but they can all be recognized by several characteristic features which should be taken together. They all have gills which change from creamy-white or pale-pink to dark chocolate-brown and which are not attached to the stem but hang freely from the cap, a ring which is always present on young specimens, though it may disappear altogether later on, and no volva or cup at the base of the stem.

It is one of the tastiest of mushrooms and whether fried, stewed or prepared in any other way is equally delicious.



Agaricus campestris.

EDIBLE

Agaricus arvensis (= *Psalliota arvensis*)
THE HORSE MUSHROOM

CAP: up to 22 cm in diameter when expanded, but ususally smaller, at first almost spherical, then flattened, creamy-white, sometimes becoming creamy-yellow and often thickly covered with tiny brownish scales, usually light buffy-brown in the button stage.

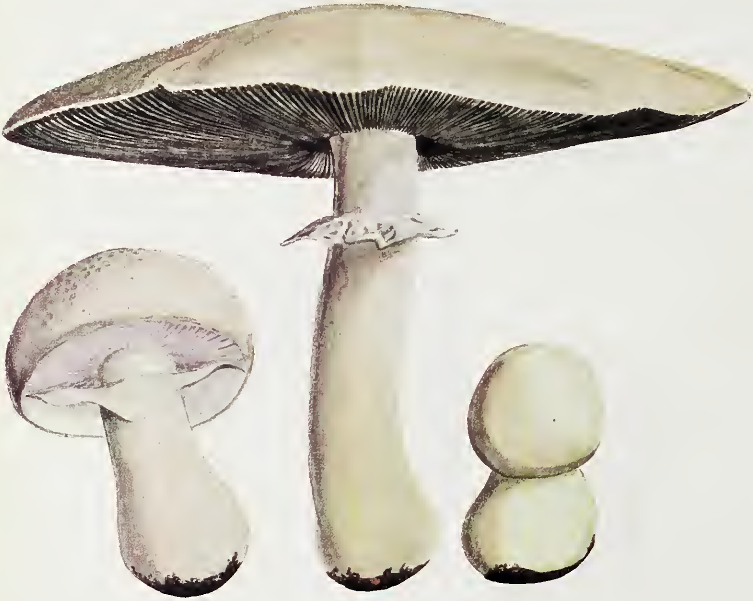
STEM: up to 9 cm long and up to 3 cm in diameter, white, the lower half sometimes tinted yellowish-brown, smooth, equal but often somewhat bulbous at the base, solid, but becoming slightly hollow later on. *Ring* large, white, usually with brownish floccose fragments below, attached fairly high up, persistent or disappearing in old specimens. Very characteristic of this species is the yellowish liquid which exudes from the stem when fresh specimens are first cut.

GILLS: remaining white to creamy-white for quite a long time, then changing to dirty pink and finally chocolate-brown to almost black, not touching the stem and rather crowded.

FLESH: firm and white, but when cut or broken it turns rather yellow and even rusty-brown later on; odour and taste agreeable.

SPORE PRINT: dark purplish.

Varieties of this species occur in late summer and autumn and are found amongst grass in places where cattle and horses have been grazing, in manured gardens, horse manure heaps and grassy places between trees. It is very like the Common or Field Mushroom but differs mainly in the larger size and the fact that the gills remain whitish for much longer before changing colour. It is also an excellent edible mushroom and especially tasty with meat dishes.



Agaricus arvensis.

THE GENUS AMANITA

This genus includes the most deadly poisonous species of mushrooms, though some are edible and perfectly wholesome. Not many species of *Amanita* have been found in the Transvaal, but specimens of at least three of its poisonous species have been collected in this province namely, *Amanita phalloides, A. pantherina* and *A. muscaria.*

Most *Amanita* species are large fungi and usually grow under trees. They have three distinct characteristics: they all have white gills and spores, a ring and a cup, also known as a volva, at the base of the stem. The volva is the remains of a membrane which enveloped the young plant. As the stem lengthened the cap pushed up against the membrane and finally broke it, leaving the lower half as a cup fastened to the base of the stem. The characters of the volva however vary in different species, for instance in *Amanita phalloides* it is large and well developed, while in *A. muscaria* it is reduced to scales forming concentric ridges round the bulbous base.

The volva of *Amanita* species can usually not be seen as it is underground. When picking an unknown mushroom, care should be taken to dig out the stem to find out if it has a volva. Should the mushroom be pulled out by the stem the volva, if present, might remain behind. When handling any of the very poisonous *Amanita* species like *A. phalloides,* the hands should be washed afterwards because many of the poisonous spores of the fungus are likely to have fallen on them. For this reason an entire collection of edible mushrooms should be discarded if one single specimen of a poisonous species is found amongst them.

DEADLY POISONOUS

Amanita phalloides

THE DEATH CUP

CAP: 5-15 cm in diameter, olive-green, smoky brownish-green, yellowish-green, shading from cream at the margin to yellow, to green at the centre, always darker towards the centre and paler towards the even margin, smooth and rather sticky in damp weather and shiny when dry, giving the surface a satiny appearance, bell-shaped, later becoming flat.

STEM: 7-17 cm long and 1-2.6 cm in diameter, white, smooth, solid at first but hollow later on, narrower above than below, thickening at the base which is sheathed by a partly free cup (volva) often lobed at the top. *Ring* fairly large, white, attached to the upper part of the stem, hanging downwards.

GILLS: white, not touching the stem and rather crowded.

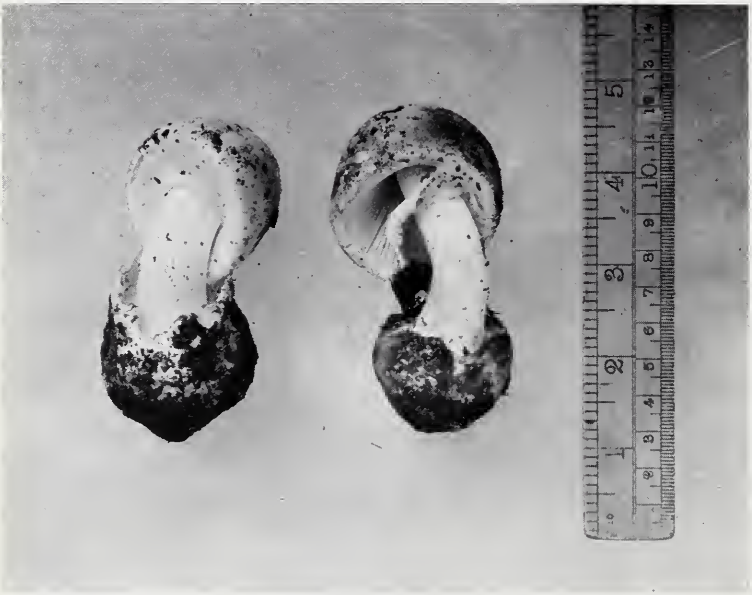
FLESH: white, with a yellowish-green tinge under the skin of the cap, odourless when young but with an unpleasant sickly smell when old.

SPORE PRINT: white.

This mushroom usually occurs under or near oaks, pines and poplars. Until 1955 it had never been recorded in the Transvaal. In the autumn of that year it appeared in great profusion under oaks in Ermelo after heavy rains and was responsible for the deaths of four children and a Bantu who had picked and eaten specimens. Since then it has again been collected a few times.

Amanita phalloides is so dangerous because usually no ill effects are felt until about 10-12 hours after eating. Effects may be felt as early as 6 hours after a meal or may be delayed for up to 48 hours. The *symptoms* are many and varied, chiefly violent abdominal and muscular cramps, intense thirst, sweating, violent vomiting, diarrhoea and at the end delirium, complete collapse and death.

Treatment: The patient should be taken to a hospital for treatment with all speed, but in cases where this is not possible and a doctor cannot be reached a purgative should be given in the meantime. To help lessen the nausea small mouthfuls of a weak, non-emetic solution of salt (one teaspoonful salt in a glass of cold water) may be taken before the purgative. A weak solution of glucose should also be given at intervals, but no alcohol.



Amanita phalloides.

POISONOUS

Amanita pantherina

THE WARTED MUSHROOM

Cap: 5-13 cm in diameter, rounded at first, then flat, sometimes turning up at the striate margin later on; rather variable in colour, smoky-brown or greyish olive-brown, sometimes pale olive-buff when young, covered with numerous white scabs or warts arranged in more or less concentric circles, many of which wash off in the rain; rather sticky to the touch when young.

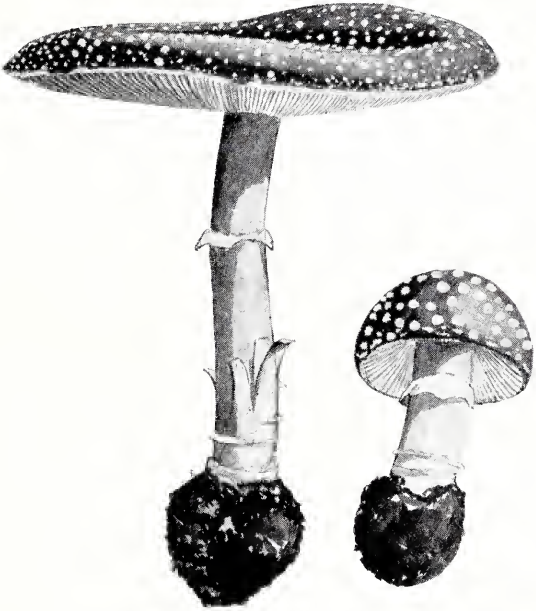
Stem: up to 13 cm long, but usually less, about 1-1.8 cm in diameter, white or dirty white, firm, smooth, soon becoming hollow, of uniform diameter, except at the somewhat bulbous base enclosed underground in a cup (volva) above which are one or more ridges of somewhat torn tissues. *Ring* a little above the middle of the stem, white, becoming torn.

GILLS: white, drying a dirty, light yellowish-brown, just reaching the stem, but free from it.

FLESH: remaining white with perhaps just a faint tinge of yellow when old. It has no distinctive odour or taste.

SPORE PRINT: white.

Amanita pantherina comes up after heavy rains and is found under trees of all kinds but especially under blue gums in the Transvaal, where it is fairly common. It is not nearly as deadly as *A. phalloides,* but more poisonous than *A. muscaria. Symptoms* usually develop from 1-3 hours after a meal. *Treatment*: An emetic if necessary, but a purgative should also be given because small pieces of mushroom may still have remained in the alimentary canal even though there has been considerable vomiting. The use of the drug atropine is not always advisable.



Amanita pantherina.

POISONOUS

Amanita muscaria

THE FLY AGARIC

CAP: 4-18 cm in diameter, usually bright red, but sometimes a reddish-orange or paler, marked with thick white or yellowish scabs scattered over the whole surface; spherical at first, then convex and finally expanding to nearly flat; sticky when moist but slightly shiny in dry weather.

STEM: 5-20 cm long and 1-3 cm in diameter, white or creamy yellow, firm, swollen at the base where the only signs of the cup (volva) are a series of partial ridges of fragments of scabs or warts round the bulbous base. *Ring* attached to the upper part of the stem, soft, white or slightly yellowish, often drying up and disappearing.

GILLS: white or creamy-yellow, crowded together, close round the stem but not touching it, often further away when dry.

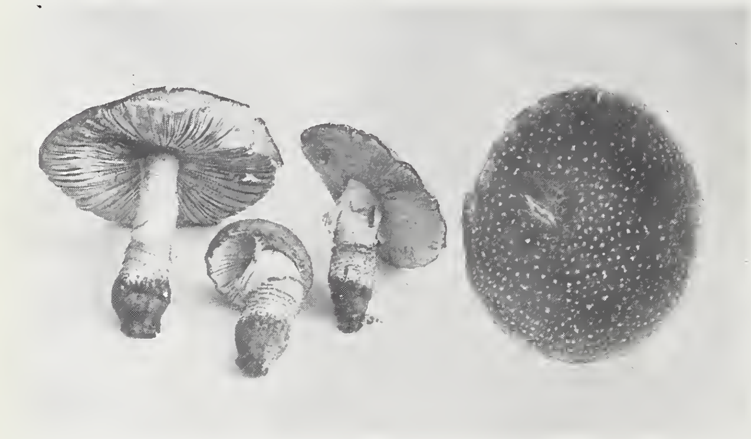
FLESH: white or creamy-yellow and noticeably yellow under the skin of the cap; it has no marked odour and some say that it has an agreeable taste while others maintain that it is bitter.

SPORE PRINT: whte.

Amanita muscaria is almost always found under pines and more rarely under oaks after heavy rains. Though not very common in the Transvaal, it has been collected quite often in the eastern and sometimes in the southern parts of this Province.

The fungus has a fatal attraction for flies. They often cluster around, drink the dew off the cap, then fly and buzz about in frenzy until death suddenly overtakes them.

This mushroom is no longer regarded as being highly poisonous to human beings and unless a great deal is eaten the patient usually recovers quite quickly. The *symptoms* which manifest themselves from 1-3 hours after eating include nausea, retching, vomiting, giddiness with confusion of ideas and sometimes hallucinations, ending with delirium and loss of consciousness for a time. *Treatment*: If the patient has not already vomited sufficiently, an emetic should be given and then a purgative. The patient must not on any account be given any alcohol.



Amanita muscaria.

EDIBLE

THE GENUS TERMITOMYCES

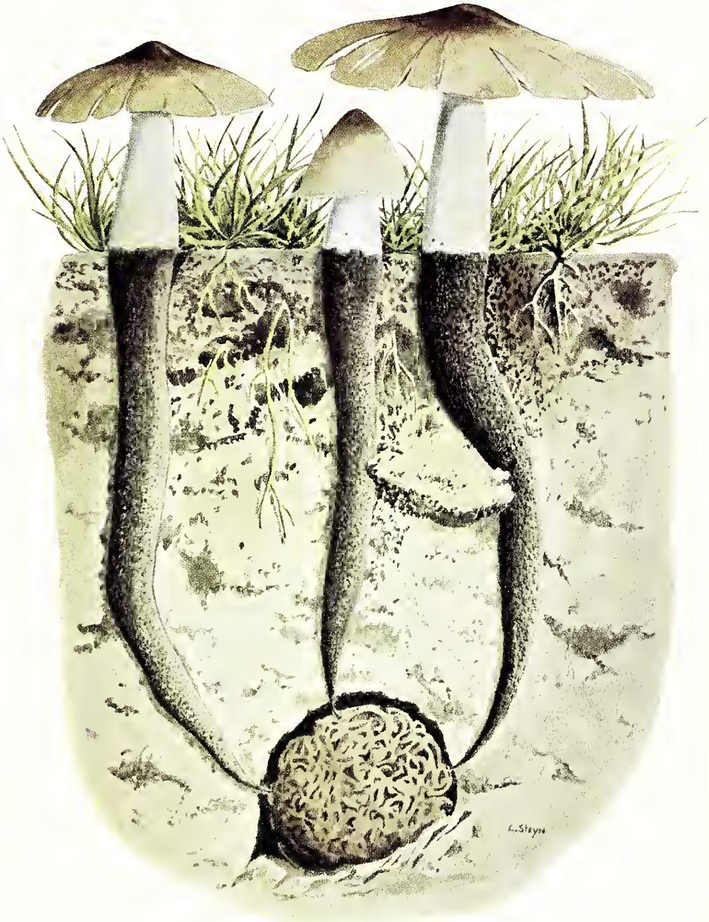
The Mushrooms growing out of living Termite Nests

Mushrooms belonging to the genus *Termitomyces* have one very distinct characteristic: they all have long rooting stems attached to termite nests hidden under the ground. The cap usually has a prominent hump, known as an umbo, in the centre. They are all edible.

In the Transvaal and the area in and around Pretoria several varieties of two species in particular are found:-

1. One species has an annulus or ring round the stem and for this reason I shall call it the "annulatus" form of *Termitomyces.*

2. The other species, *Termitomyces cartilagineus* has several forms. It has no ring, and the Transvaal varieties usually have a darker cap.



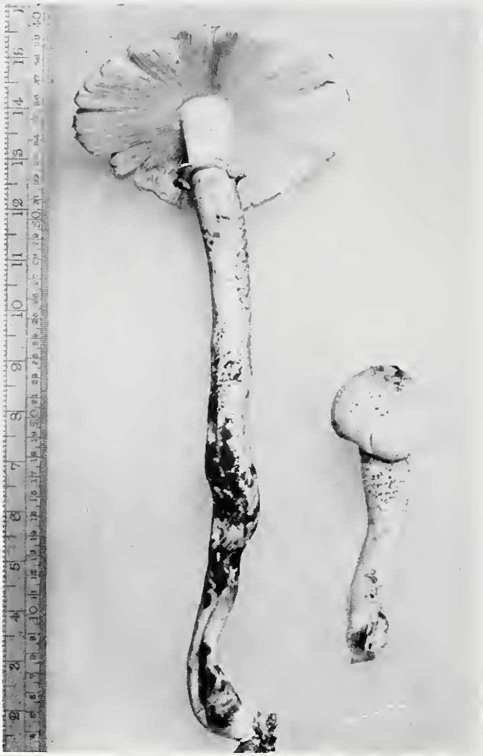
Termitomyces sp.

EDIBLE

"Annulatus" form of TERMITOMYCES species

CAP: usually about 10 cm, but up to 18 cm in diameter, pure white at first, but turning pale cream to brownish-tan, especially at the slightly humped apex; spherical at first but expanding to hemispherical, the incurved margin sometimes splitting a little. When the atmosphere dries quickly after rains the cap is prevented from expanding fully. The pale brownish thicker skin on top often cracks and turns up slightly all round the apex, giving the cap the appearance of having a slightly torn, flat little hat perched on its crown.

STEM: up to 67 cm long, but usually about half this length, up to 3.5 cm in diameter at the thickest point, but abruptly narrowed above the termite nest to which it is attached by a narrow, short cylinder of tissue, slightly scaly above ground, hollow underground, white or soon creamy-yellow or darker when old; above ground below the ring the fine scales are often discoloured by earth, resulting in snake-like markings, above the ring pure white, becoming cream and slightly striate. *Ring* situated high up, 2.0-2.5 cm below the point where the gills near the stem, immovable and stiff and cracked in places when dry.



Termitomyces "annulatus" form.

Gills: white or pale buff, becoming pinkish-buff, not touching the stem, but coming very close to it.

Flesh: white, firm.

Spore Print: pinkish-buff.

This mushroom appears in summer after heavy rains. It occurs in gardens, back-yards, alongside roads and in open spaces, often near trees. It is edible but very tough and not as palatable as most other *Termitomyces* species and is best fried in butter for a long time. The taste is pleasant, like sweetcorn or underdone chicken or egg-fruit, but not at all like that of most other mushrooms.

EDIBLE

Termitomyces cartilagineus (*Transvaal varieties*)

Caps: up to 11 cm in diameter, pale tan to brown, always darker at the apex, conical at first, then expanding to broadly convex, with a slight mound on the darker centre, splitting at the margin, smooth, moist and slightly tacky to the touch when young, but becoming hard and dull when dry.

Stem: usually between 20 and 40 cm long with about $^1/_4$-$^1/_3$ of its length above ground, 1.5-3 cm in diameter, smooth, becoming longitudinally furrowed, often, though not always, thickening up to 4 cm at soil level, then tapering to a long, thin root-like point where attached to the termite nest; white to creamy-yellow, becoming brownish when dry above ground, but dark-brown or almost black below ground. *Ring* absent.

Gills: white or cream, becoming pinkish-buff, not touching the stem and easily breaking away from the cap.

Flesh: white, compact and firm, thick in the centre, but thin at the margin; taste very pleasant.

Spore Print: Pinkish-buff.

It occurs in gardens, parks, alongside roads and in open grassy places during the summer after rains.

The mushroom known as the "Natal Beefsteak Mushroom" and called "I'kowe" or "Umkowaan" by the Bantu has also been found in the Transvaal occasionally. It is probably a large variety of *Termitomyces cartilagineus*. The cap is up to 25 cm in diameter and is lighter in colour, usually white or pale tan. The stem thickens up to 6.5 cm in diameter at soil level and tapers underground to a long narrow point where attached to the termite nest. It is white above ground but dark to black underground. The flavour of this edible species, well known to the Bantu, is said to be of rare excellence. It is especially delicious if sliced and fried in butter.

EDIBLE

Lepiota zeyheri

THE SOUTH AFRICAN PARASOL MUSHROOM

Cap: 10-20 cm in diameter, spherical at first, then convex becoming more or less flat except for a small hump in the centre; white, with a clay-brown patch on the humped centre, while the rest of the surface is covered with brown scales arranged in circles which gradually become paler towards the outside; margin often fringed at first.

STEM: 10-23 cm long, 1-2 cm in diameter, usually longer than the cap is wide, firm, hollow or only slightly stuffed, swollen at the base, white or cream, becoming reddish-brown if handled. *Ring* large, white to slightly discoloured, rather frilly, movable.

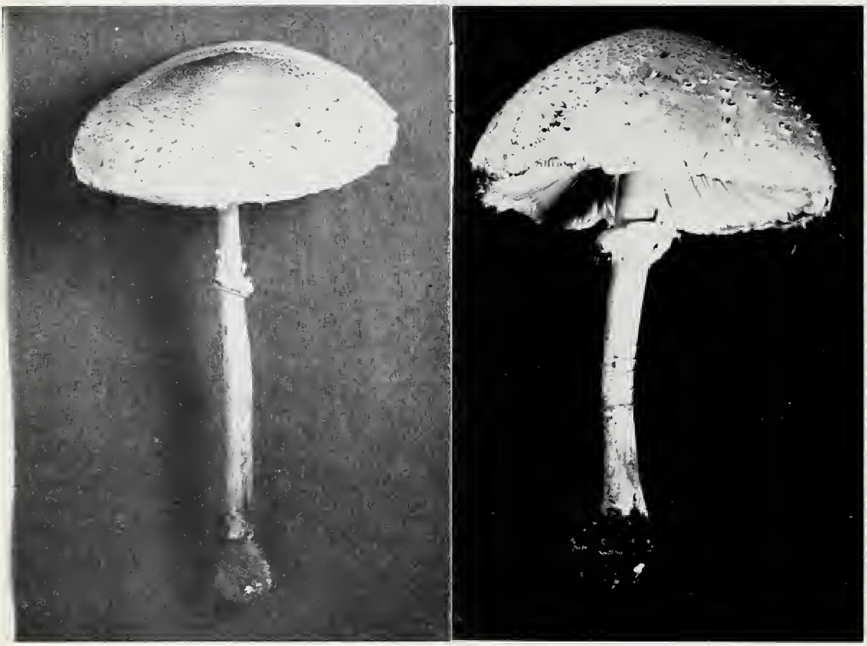
GILLS: white, becoming cream or pale tan when old, well separated from the stem, closely crowded together.

FLESH: white, thin. It has a very faint pleasant mushroom odour and a taste which is agreeable to some people, while others find it rather rancid.

SPORE PRINT: white, sometimes with a very pale pinkish tinge, cream later on.

This picturesque edible mushroom occurs quite often in the Transvaal and can be found in a variety of situations such as alongside roads, in grassy patches, on ground in the open veld and in groups under various trees, but not in dense bush nor in forest plantations.

Although *Lepiota zeyheri* is an edible species, care should be taken to ensure that it has not been confused with the very similar False Parasol Mushroom. For this reason a spore print should always be made first in order to establish whether the spores are white and not green. On the other hand it must also be remembered that though this white-spored mushroom is edible, all the *Amanita* species also have white spores and many of them are very poisonous.



Lepiota zeyheri (reduced in size).

Lepiota molybdites

THE FALSE PARASOL MUSHROOM

This mushroom is perhaps better known under the old name of *Lepiota morgani*. It is also ralled *Chlorophyllum molybdites* by some botanists who place it in the genus *Chlorophyllum* because, unlike all the other *Lepiota* species, its spores are green and not white.

CAP: 7-30 cm in diameter, at first subglobose, then convex for quite a long time, finally expanding to almost flat, often with a very slight hump in the centre; white with a pale buffy-brown patch of skin in the centre, surrounded by irregular fragments of this skin which dot the cap, especially around the dark centre; margin incurved at first.

STEM: 10-20 cm long, usually shorter than the expanded cap is wide, 1.2-2.5 cm in diameter above and increasing to 4 cm at the rather swollen base, firm, stout, stuffed with fibres, white or greyish-white, changing to rusty-brown when bruised or handled. *Ring* large and whitish, round the upper half of the stem, movable.

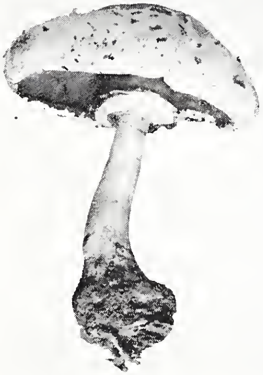
GILLS: white until the spores begin to fall when they turn rather a dirty, dull olive-green and, when quite dry, a buffy-brown colour; not touching the stem and rather close together.

FLESH: white, thick, firm.

SPORE PRINT: pale green at first but soon becoming dirty, dull green.

Unlike most poisonous mushrooms *Lepiota molybdites* does not usually grow in woods under trees but is more often found in open grassy places and in other richly manured and well watered damp spots. It occurs chiefly in the Transvaal but also in Natal and the eastern Cape and South West Africa. It is plentiful in very wet rainy seasons but rare at other times.

It is not a very poisonous mushroom, but if eaten most people will suffer a severe attack of vomiting and diarrhoea afterwards. Sometimes this is followed by a state of stupor for a while. The patient should rest, keep warm and be given a purgative.



Lepiota molybdites.

EDIBLE

Podabrella microcarpa

Cap: always small, 0.5-2 cm in diameter, rarely longer, bell-shaped with a sharply pointed humped centre, expanding to broadly convex causing the margin which was incurved at first to split and become uneven and lacerated; young specimens pure white, but becoming dirty white later, varying from cartridge-buff to orchraceous-buff and even to brownish colour when dry, with the humped centre usually slightly darker.

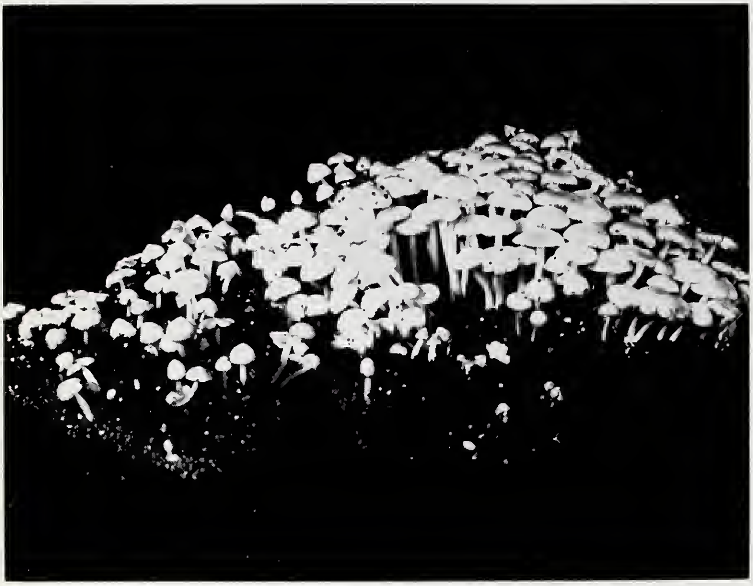
Stem: 1.5-4.5 cm long and 1.5-3.5 mm in diameter, solid, slender, fibrous, even, but slightly bulbous at the base which is usually attached by sparse white mycelium to small round bodies composed of fungus threads (hyphae) about 1-1.5 mm in diameter which have been ejected from termite nests by the termites. No ring present.

Gills: white, turning light buff later on, free from the stem but very close to it at first.

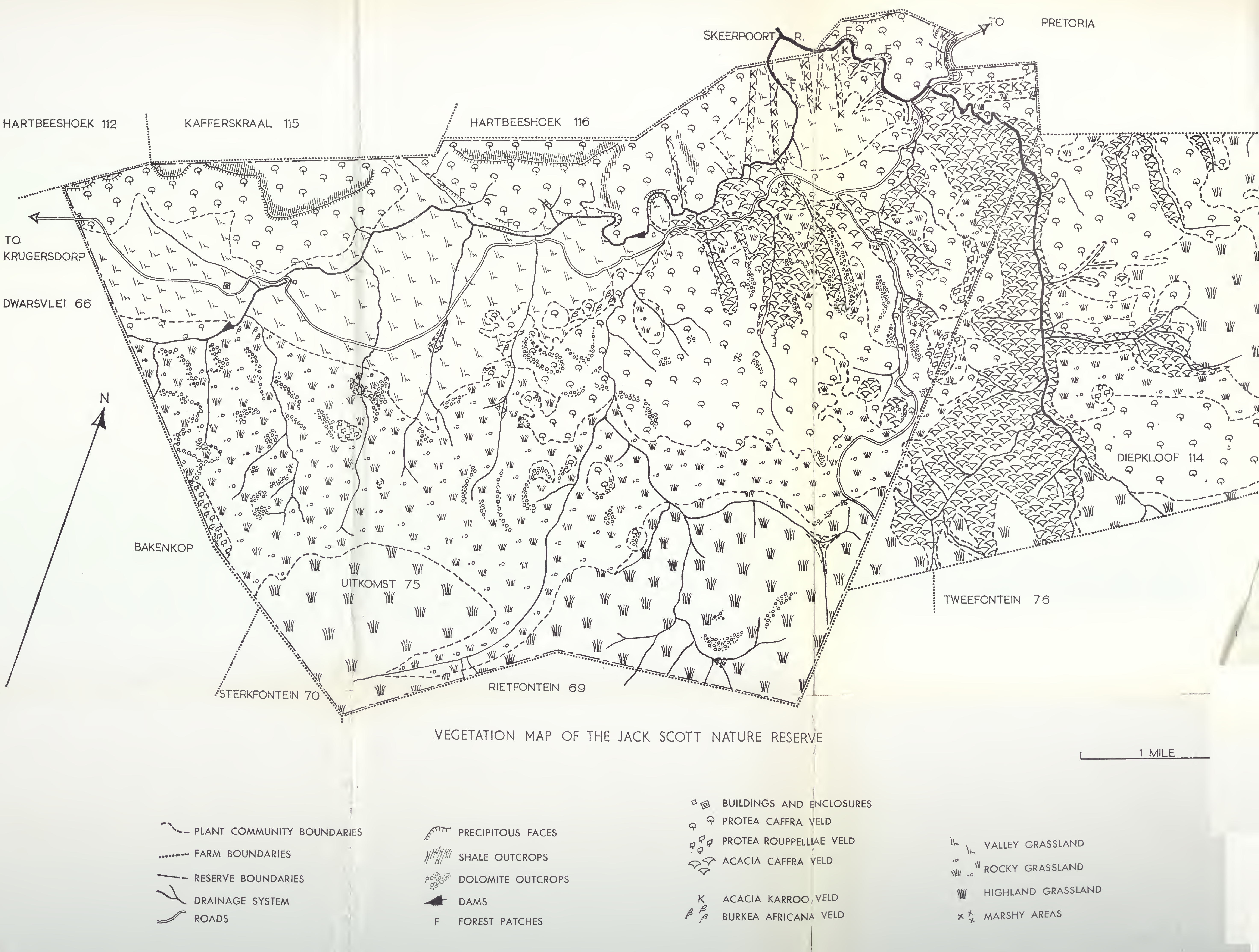
Flesh: white, thin, firm; no odour, taste delicious.

Spore Print: light pinkish-buff to pale chamois or light clay colour.

This small edible mushroom usually comes up after rainy spells. It grows in dense clusters on superficial "termite soil". It was at one time considered to be a subgenus of *Termitomyces* as it is usually found near termite nests. It differs from this genus in several respects but chiefly in that it has no root-like extension of the stem attached to an underground termite nest.



Podabrella microcarpa.



VEGETATION MAP OF THE JACK SCOTT NATURE RESERVE

The Vegetation of the Jack Scott Nature Reserve

M. J. Wells

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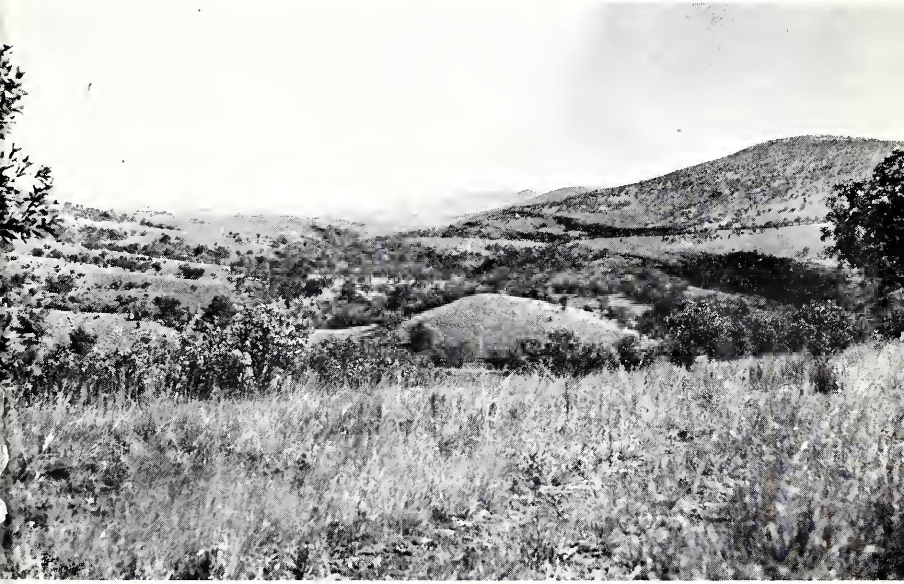
THE Jack Scott Nature Reserve lies in the catchment of the Skeerpoort River between the Hartbeespoort Dam and Krugersdorp. The Reserve includes one veld type only, the Central Bankenveld, but this type has several topographic variations (Fig. 1).



1. A view of Central Bankenveld in the Jack Scott Nature Reserve showing *Protea caffra* Veld in the foreground and on the shale hills on the right-hand side of the picture. Streambank woodland develops to form forest patches in the shelter of shale krantzes. Mixed tree communities and grassland cover the lower slopes of dolomite koppies on the left-hand side of the picture.

Photo: D. J. B. Killick.

The soils of the Reserve are poor and acid, stony and sandy, and are derived from two main rock types: shale, which outcrops as steep krantzes along the Skeerpoort River, occurs north of the Reserve's road; and dolomite, which outcrops as rocky koppies, is found south of the same road. The *Protea*-covered dolomite koppies dominate the landscape of the Reserve, whilst the shale krantzes provide sheltered habitats where small pockets of forest develop. Fault-lines through the shale are marked by lines of Sweet Thorn (*Acacia karroo*) whose long tap-roots find extra moisture in the fissures. Streambank woodland and vlei communities, which seldom occupy an area large enough to appear on the map, fringe the many watercourses.

Rainfall records from Hartbeespoort Dam and Zeekoehoek (2) indicate that the Reserve, which lies between altitudes of 4,300 feet and 5,300 feet above sea-level, probably receives a mean annual rainfall of between 25 and 27 in. It is somewhat lower and drier than is typical of Central Bankenveld areas. In drought years most parts probably receive less than 15 in rainfall. Even in normal years the winters are very dry because 85 per cent of the rain usually falls during the six summer months October to March.

Temperature records from nearby stations (2) indicate that a wide temperature range is probably experienced in the Reserve during the year. On open slopes the highest mean monthly maximum temperature is approximately 34°C (93°F), and north-facing valleys are probably 3 or 4° warmer. The lowest temperatures experienced in the Reserve range from approximately 1°C (33.8°) on open hill-sides to -6°C (21.2°F) in the deeper valleys, where frost is usually experienced between May and August.

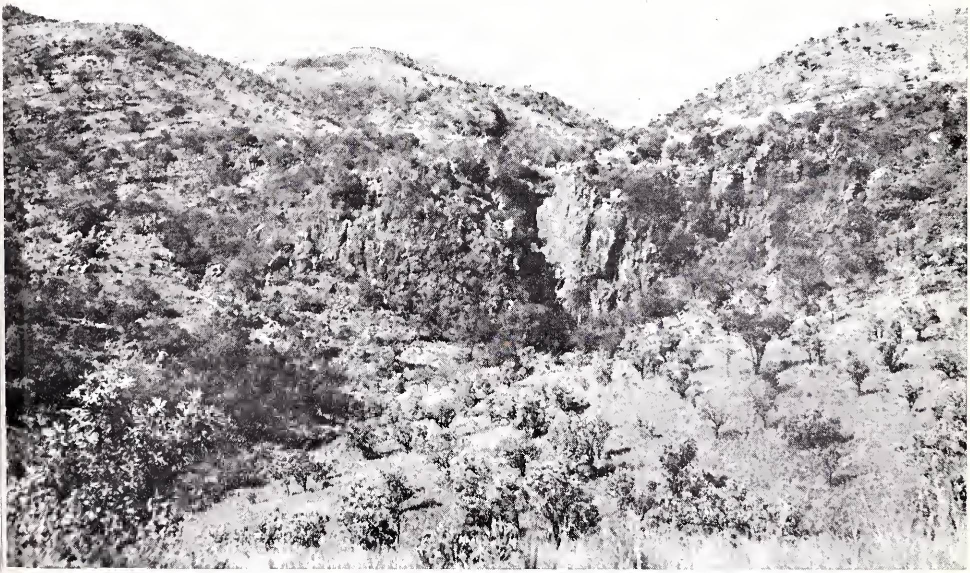
Typically under these climatic and soil conditions, and when exposed to regular burning, the grass of the Central Bankenveld is sour and wiry and not easily grazed by domestic stock in winter. Much of the grassland of the Reserve, which is burnt every two years, is sour, especially on the dolomite areas. However, grazing game such as zebra, wildebeest, reedbuck and blesbok have so far survived the winters well, perhaps since relatively 'sweet' grass species such as Red Grass (*Themeda triandra*) are also common in the Reserve.

Acocks (1953) writes of the typical Central Bankenveld: "Rocky hills and ridges carry a Bushveld vegetation dominated by *Acacia caffra, Protea caffra, Celtis africana* and sometimes *Protea welwitschii* with a large number of the Sour Bushveld shrubs in smaller quantity. A typical plant of the hills is *Vellozia retinervis*. In sheltered valleys and sink-holes there are traces of temperate or transitional forest, with such species as *Celtis africana, Kiggelaria africana, Halleria lucida, Leucosidea sericea, Buddleia salviifolia* and *Cassinopsis ilicifolius* contrasting with the traces of tropical forest a few miles away in the kloofs of the Magaliesberg. This description provides an admirable picture of the vegetation of the Reserve except that, as might be expected in an area drier than typical Central Bankenveld, the White Stinkwood (*Celtis africana*) and the Dwarf White Sugar-Bush (*Protea welwitschii*) are not common on open hill slopes, and the gnarled Ouhout (*Leucosidea sericea*) is comparatively rare. Acocks also notes that stands of the common Thatching Grass (*Hyparrhenia hirta*) are common on the ancient lands once cultivated by Moselekatze's people and that overgrazing brings an abundance of Slangbos (*Stoebe vulgaris*) on sandy places, and of the Bush Everlasting (*Helichrysum kraussii*) on rocky ridges. However, the Reserve is too hilly and stony to lend itself to cultivation, and only the old lands near the west gate carry large stands of *Hyparrhenia hirta*. These old lands are a favourite haunt of wildebeest and other grazing game. The grassland of the Reserve is in good condition and little shrub invasion has taken place. On the other hand, tree invasion is proceeding slowly but surely over most of the Reserve, though there is little likelihood of tree growth resulting in a serious diminution of grass growth.

The most obvious tree invasion is taking place near the west gate, where the Transvaal Sugar-Bush (*Protea caffra*) is re-invading the old lands from which it was cleared many years ago. The Wild Seringa (*Burkea africana*), used by some native tribes as a fish poison and easily identified by the reddish-brown fur on its buds, is colonizing rocky grassland between *Protea* communities south of the main road. Some of the *Burkea* stands are so dense as to almost warrant designation as thickets, but competition as the individuals grow larger will probably result in thinning out.

The dark-leaved Sweet Thorn (*Acacia karroo*) is invading tall grass communities along the streambanks, and streambank woodland is being thickened into a dense tangle by upgrowth of the bluish-leaved Cat-Thorn or Kaffir-wag-'n-bietjie (*Acacia caffra*). Beneath this tangle, young forest trees such as White Stinkwood (*Celtis africana*), Wild Peach (*Kiggelaria africana*) and Cape Chestnut (*Calodendrum capense*) are growing up.

There is also a tendency for the Cat-Thorn (*Acacia caffra*) (Fig. 2), to invade mature *Protea caffra* communities on the hill-sides. Here, however, it grows as a substantial tree which shows no sign of turning the open tree-veld into a dense tangle.



2. Dolomite koppies with *Acacia caffra* dominant on the left-hand side of the picture. *Protea caffra* is dominant in the foreground. Exceptionally large specimens of *Urera tenax* occur on the krantz.

Photo: D. J. B. Killick.

A puzzling feature of the Reserve is the scarcity of the Transvaal Sugar-Bush (*Protea caffra*) in the large area of rocky grassland which lies east of Bakenkop. There is no obvious change in rock formation, soil, aspect or climate to account for the lack of *Protea* trees, which are common elsewhere in the Reserve and outside its fence, west of Bakenkop. It can only be surmised that all Protea trees were cleared from the rocky grassland area many years ago, and that regeneration is proceeding very slowly, because no parent plants were left to provide seed in the cleared area.

Three grassland types have been mapped (see vegetation map), namely high grassland on the plateau top, rocky grassland on the slopes, and valley grassland on the undulating foot-hills. However, these are really topographic subdivisions which have been plotted more for convenience of grazing management than to reflect community differences. What differences do exist between the three grassland types are mainly structural and seldom reflect great differences in species composition.

Among the commonest dominants throughout the three grasslands are: Copper Wire Grass (*Elyonurus argenteus*), Russet Grass (*Loudetia simplex*), Red Grass (*Themeda triandra*), Hairy Trident Grass (*Tristachya hispida*) and *Trachypogon spicatus.* However, many other species are locally dominant. Among the most noteworthy of these are: Turpentine Grass (*Cymbopogon excavatus*) which is especially common in parts of the high grassveld and at bush margins, Old Lands' Grass (*Eragrostis chloromelas*) which borders the roads, and Centipede Grass (*Urelytrum squarrosum*) which is commonest on parts of the valley flats.

The most obvious grassland variation occurs on and about rock outcrops, where whole hill slopes have a bluish tussocky look by comparison with their surroundings. This grassland variation is best seen on the east-facing slopes of the valley up which the road to Diepkloof runs. On close inspection these stony slopes are found to be covered by short wiry grasses among which Three-awned Grasses (*Aristida* spp.) are dominant.

Another grassland variation is the tall closely matted growth of Tambookie or Thatching Grass (mainly *Hyparrhenia* and *Cymbopogon* spp.) which occurs beneath open *Acacia* woodland near streams — a favourite haunt of bushbuck.

Then there are very many grasses whose presence is only noticed seasonally, when they flower and seed. Among these the most important are: the Sour Buffalo Grass (*Panicum natalense*) the Sticky-stem Lovegrass (*Eragrostis gummiflua*), Timothy Grass (*Setaria perennis*), Boat Grass (*Monocymbium ceresiiforme*), Herring-bone Grass (*Pogonarthria squarrosa*) and the common Natal Red-top (*Rhynchelytrum repens*). Rolling Grass (*Trichoneura grandiglumis*), in common with the pink lily-like *Boöphane disticha,* has a flower head which breaks off when it dries and is blown over the veld like the tumble-weed of the dry American prairies. Because the rolling flower-heads often frighten horses, *Boöphane* is known in Afrikaans as 'Perdespook', and this name might also be applied to the rolling grass-heads.

None of the grasses is poisonous when fresh, but some generate poisonous prussic acid as they wilt, and in times of drought it is best to keep cattle away from large stands of wilting Aapstert-steekgras (*Artistida* *congesta*), Red Grass (*Themeda triandra*) and common Drop-seed Grass (*Sporobolus fimbriatus*).

Among the most attractive grassland herbs are the wild *Gladiolus* species, the Wild White Carnation (*Dianthus mooiensis*) and Wild Hemp (*Leonotis microphylla*) which provided native tribesmen with a heady 'water smoke' long before Indian hemp (*Cannabis sativa*) 'dagga' or 'marijuana', as it is commonly known, became widespread in southern Africa. Other attractive grassland herbs are the Wild Scabious (*Scabiosa columbaria*), the Blue Daisy (*Felicia muricata*) and the yellow-flowered Wandering Jew (*Commelina diffusa*) so named because it seems to penetrate almost every plant community, from shaded streambank marsh to sun-dried rocky turf. Also of interest is the little Everlasting (*Helichrysum caespititium*) which frequently grows out of holes made by harvester termites.

The streambanks are rich in plants which seldom occur elsewhere in the Reserve. Among the water-loving grasses are the creeping Quick Grass (*Cynodon dactylon*) which is often used in city lawns, Turf Grass (*Ischaemum arcuatum*), Silver Thread Grass (*Andropogon eucomus*) and Rescue Grass (*Bromus wildenowii*) so named because it once saved farmers from great stock losses. Other streambank grasses include the Red Vlei-grass (*Hemarthria altissima*), Cottonwool Grass (*Imperata cylindrica*), and the Common Reed (*Phragmites*) which occurs all the way up the coast of Africa to the papyrus swamps of Egypt.

Among the most distinctive sedges are the Mat-sedge (*Scirpus corymbosus*) and the Six-angled Sedge (*Cyperus sexangularis*) which resembles its larger cousin *Cyperus papyrus*, from which the ancient Egyptians made their scrolls.

All sedges do not grow near water. Many, such as the Monkey Bulb (*Mariscus capensis*) and the Fluffy Sedge (*Bulbostylis burchellii*), grow in dry open grassland — and it is worth noting that in some tropical 'grasslands' there are far more sedges than grasses present.

Neither are sedges the only waterside herbs other than grasses. Many soft-leaved species such as the blue-flowered *Lapeirousia sandersonii*, the pink-flowered *Oenothera rosea* and the Wild Plantain (*Plantago major*), not to be confused with the edible banana-like Plantains (*Musa* spp.), occur along the streambanks. *Plantago major*, an attractive plant with its spreading leaves and tall spike of minute green flowers, is used by Whites and non-Whites for earache and for numerous other maladies ranging from malaria to whooping-cough. The plant harbours an astringent formerly much valued by the ancients, and it is still used in Japan for whooping-cough (4). Yet another water-plant of interest is the Water Buttercup (*Ranunculus multifidus*). This innocent looking plant contains a poison deadly to sheep at certain seasons and in certain localities (3). No reason for the variation in effect of this plant has yet been established. Also of interest is the Granny-bonnet Orchid (*Habenaria tridens*) which grows in moist streambank rock crevices.

Hot, dry, streambed crevices which are seldom flooded are the home of leafless succulents or bulbous plants — all of which conserve or store water in one way or another. One such succulent is the decorative foul-smelling *Stapelia nobilis* which is common along hot, rocky, river-beds. An example of a bulbous species is the tiny lily *Litanthus pusillus*, many bulbs of which may crowd into a crevice an inch long and a sixteenth of an inch wide.

A leafless water-plant is the Horsetail or Scouring-rush (*Equisetum ramossissimum*), one of the few remaining members of an ancient family which dominated the swamps of prehistoric ages. *Equisetum* is known in Afrikaans as 'dronkgras' because, when stock eat too much of it, they become giddy and wander aimlessly over the veld — sometimes falling or slipping to their deaths (3).

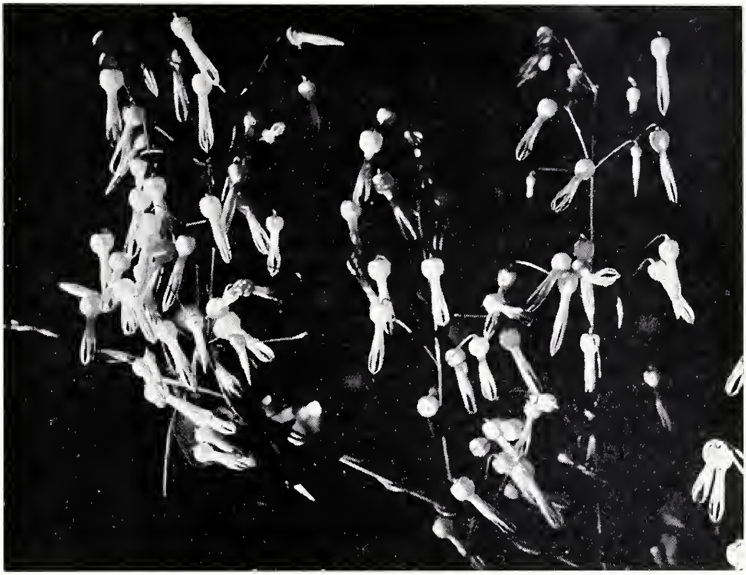
Few woody plants specialized to grow in or beside flowing water occur in the Reserve, but among those that do occur are the Natal Willow (*Salix woodii*) and the Water Tree (*Ilex mitis*) which is closely related to the European and American holly trees. Woody plants which frequently occur near streams include the Mountain Sagewood (*Buddleia salviifolia*) with its long grey leaves and *Halleria lucida* which, like *Leucosidea sericea*, is known as 'ouhout' because even young trees have an old appearance being gnarled and twisted and covered with rough bark. *Halleria* has an added attraction in early spring when ranks of brilliant orange candle-like flowers grow out from the old wood, usually on the most shaded branches.

Other plants of the streambank woodland include the Crow Bush (*Hetermorpha trifoliata*), the Wild Medlar (*Vangueria infausta*), the Mountain Knobwood (*Fagara magalismontana*) and the shiny-leaved Wag-'n-bietjie (*Ziziphus mucronata*). The last two species mentioned are both sources of favourite native remedies for a host of ills.

Watt and Breyer-Brandwijk (1932) list knobwood species as being used by different tribes for flatulent colic and palsy, stomach complaints and worms, snake-bite, febrile conditions, gall-sickness in cattle, cold in the head, cough and pleurisy, producing sweating, pimples and blood poisoning generally, dressing for hollow teeth, tuberculosis and paralysis, bronchitis, mouth-wash, acne, sores, lesions, and as a disinfectant for anthrax-infected meat. It seems a pity that, as with so many bush remedies, there is little if any evidence of cures being effected or of the plants containing useful drugs or antibiotics. No doubt *Fagara* has two main attractions for medicine men, the first being the sour citrus-like smell of the essential oils in the leaves, and the second the prominent knobs on its trunk which led to the plant's Zulu name meaning 'porcupine teats'.

Many other woody plants occur in streambank woodland, but most of them also occur scattered through the bushveld generally, and many are especially common on low-lying stony slopes in *Acacia caffra* veld. Among the commoner of these species are the Pen-thorn (*Maytenus polyacanthus*) which is sometimes almost completely covered in a mantle of small greenish-white flowers, the Wild Pear (*Dombeya rotundifolia*) which also bears a mantle of flowers — this time large and papery white, and the Lekkerbreek (*Ochna pulchra*) whose red and black fruits are among the most beautiful in the bushveld. Less attractive bushveld trees include the Oil-seed Tree (*Pappea capensis*), Kaffir Orange (*Strychnos innocua*), the Jakkalsbessie (*Diospyros whyteana*) and the Wild Olive (*Olea africana*) — all of which bear fruit which provides the indigenous animals and human beings with food. Indeed, the Wild Olive is difficult to separate taxonomically from the cultivated olive; the two may well be derived from the same species.

An attractive creeper is *Riocreuxia torulosa* (Fig. 3) whose unusual flower-sprays festoon the trees in some places.

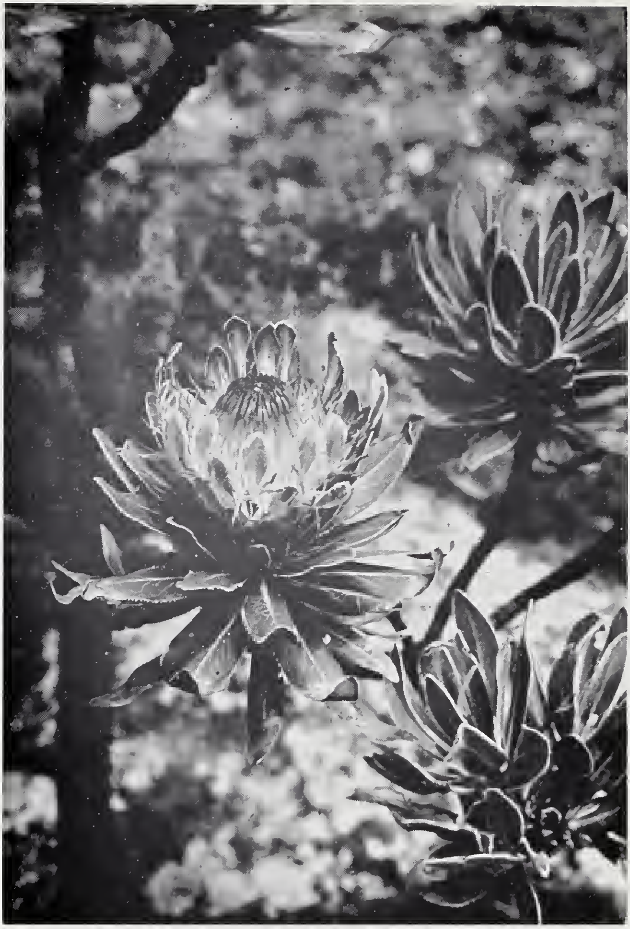


3. *Riocreuxia torulosa* in flower. Photo: M. J. Wells.

Probably the most distinctive growth forms of the bushveld are provided by the bluish-leaved Cabbage Tree (*Cussonia paniculata*), the spiny-leaved *Aloes* (*A. davyana* and *A. verecunda*) and the graceful Mountain Karee (*Rhus amerina*). Also common throughout the bushveld of the Reserve is the bird-distributed parasite Wild Mistletoe (*Viscum rotundifolium*). Clusters of mistletoe adorn almost every tree on some slopes.

Trees of rocky places include the *Gardenia*-like Aapse-kos or Candlewood (*Rothmannia capensis*) with its sweet-scented, large, white, upturned flowers, the Kaffir Plum (*Ximenia caffra*), and the Stamvrug (*Bequaertiodendron magalismontanum*). Also common on rock outcrops are the Tree Nettle (*Urera tenax*) which reaches a height of thirty feet on krantzes, the Rock Wild-fig (*Ficus soldanella*) and *Nuxia glomerata* which does not seem to have a common name, but which is one of the most beautiful flowering shrubs in the Reserve.

The only forests in the Reserve are shade developments of streambank woodland, and they usually occur at the foot of south-facing krantzes. The forests seldom exceed forty feet in height and differ from streambank woodland mainly in the greater frequency of trees such as the White Stinkwood (*Celtis africana*), the Wild Peach (*Kiggelaria africana*), the White Ironwood (*Vepris undulata*), the Moepel (*Mimusops zeyheri*) and



4. *Protea rouppelliae* in flower. Photo: D. J. B. Killick.

the Bitter Almond (*Pygeum africanum*). The forest community also differs from streambank woodland in having more soft-leaved shade-loving herbs and ferns present in the field layer.

Now that the larger plant communities have been reviewed, there remains only the duty of mentioning that most regal of all plants in the Reserve, the Silver-leaf Protea (*P. rouppelliae*), fine stands of which dominate the crowns of many dolomite koppies. Nowhere in the Transvaal have I seen better specimens of this plant — a magnificent sight during February when the ten foot tall trees are in full flower (Fig. 4). If the Jack Scott Nature Reserve had no other attractions, it would still merit a visit for the purpose of admiring these massive pink Protea blooms weighing heavily on their silver-leaved stalks.

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TIMBAVATI

Dr. S. M. Hirst

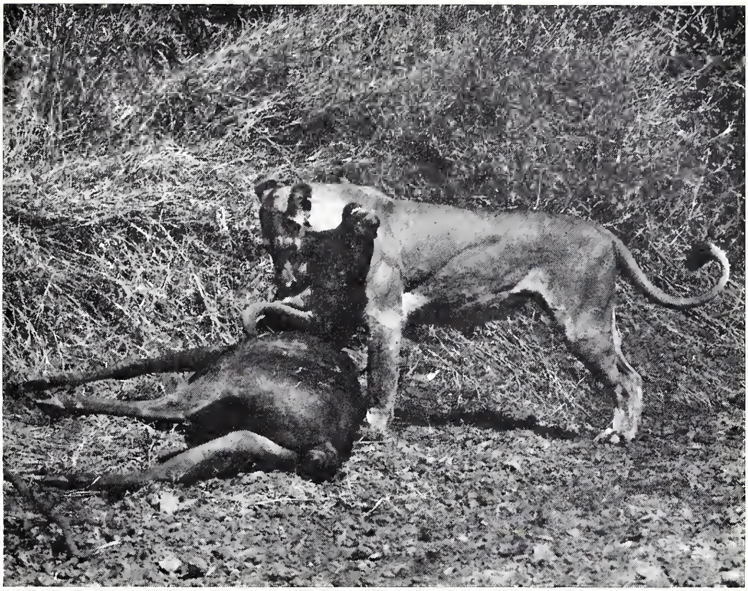
THE conservation of South Africa's wildlife has received considerable attention during recent years. The National Parks Board and the various Provincial Administrations have spent much time and money on refuges to ensure the safety of the indigenous fauna and flora. Their efforts to conserve these natural areas for posterity have received considerable publicity.

In contrast, the efforts of private landowners to preserve wildlife in private nature reserves have not been widely publicized. The majority of the public have little idea of how much such individuals do towards the conservation of natural areas and the maintenance of their plant and animal communities.

There are hundreds of private nature reserves in the Transvaal and many of these are situated in the Low Veld. Lying approximately half-way between the meandering Bushbuckridge hills and the low Lebombo Hills, which separate the Transvaal Province from Mozambique, is one of the largest private game reserves in the world. Designated the "Timbavati Private Nature Reserve", it has been in existence as an entity for nearly ten years, although individual owners have been safeguarding the wildlife in the area for more than thirty years.

Noonday drink. Two zebras accompany a large herd of blue wildebeeste to a water-hole.

Photo by Dick Reucassel, A.R.P.S.



The grip of death. A lioness and a blue wildebeest enact the age-old struggle between predator and prey.
Photo by Dick Reucassel, A.R.P.S.

The Timbavati embraces an area which, less than a century ago, abounded with thousands of game animals. Colonel J. Stevenson-Hamilton, who was warden of the old Sabi Game Reserve and later became the first warden of the Kruger National Park, refers to this fact in his book "The Lowveld, its wild life and its people". He relates that when the late Mr. W. Sanderson first saw the country south of the Olifants River in 1873, he found the whole area up to the Drakensberg foot-hills teeming with game.

By 1880 large numbers of game animals had been decimated by European and native biltong hunters. Only the presence of the dreaded tsetse fly kept the white hunters at bay during the wet season. The indigenous native tribe, the "ba-Hlangane" (or Shangaans) hunted throughout the year.

The great Rinderpest epizootic of 1896 wrought great havoc amongst the game herds. Kudu and buffalo in particular were nearly wiped out by this virulent disease.

1899 saw the commencement of the South African War. The Boer commandos hunted heavily during their forays into the Low Veld, whilst the irregular British Corps at Komatipoort, the famous (or notorious) Steinacker's Horse, employed native hunters to keep the soldiers supplied with venison. In 1902 the war ended, and Col. Stevenson-Hamilton arrived to police the Sabi Game Reserve. He found hardly any game in the area. The few remaining animals were scattered along the foot-hills of the Lebombo range.

During the 'nineties the Volksraad of the old South African Republic commissioned Mr. W. H. Gilfillan to survey the area between the Sabi and Olifants River and divide it into farms. Gilfillan, who later became the first Surveyor-General of the Transvaal, was hard pressed to name all the new farms and drew extensively on the world atlas. The result is that to-day many of the farms in the Timbavati block have such picturesque names as Sumatra, Peru and Birmingham.

The farms were at first allocated to private persons, but several large companies in Johannesburg later acquired them at low cost. It was the hope that payable deposits of gold and other minerals might be discovered. This was not the case, however, and during the late 'twenties and early 'thirties the farms were sold back to private landowners. During this period many of the Timbavati farms came under the present ownership. The land along the Timbavati River was acquired by Messrs. Piel, Pirow, Schoch and Hoheisen, whilst to the north Messrs. Battenhausen and Mostert bought several farms.

Dr. A. A. Schoch, who first entered the area in 1928, recalls that malaria was prevalent in the early days. He relates that impalas, to-day the most prolific animals in the block, were never seen in the early 'thirties, yet sable antelopes were numerous until the severe drought of 1933. During the ensuing two decades these landowners preserved the wildlife as best they could. Small rest-camps were erected and numerous dams built. The latter served as a source of water for thousands of game animals which trekked westward from the Kruger National Park during the dry winter. The owners received no monetary return for their efforts. Their reward was the recreation offered by the natural bushveld with its animals, its climate and its spirit.

A study in stripes. A herd of zebra at one of Timbavati's numerous dams.
Photo by Dick Reucassel, A.R.P.S.

Calm but cautious. A herd of giraffes keeps a wary eye on two drowsy lionesses.
Photo by Dick Reucassel, A.R.P.S.

In 1955 the owners decided to form an association to strengthen their efforts to conserve. By 1956 this was accomplished with the late Oswald Pirow Q.C. as chairman, Colonel J. D. Pretorius and Drs. P. A. Hugo and A. A Schoch as executive members and Mr. J. A. McCall-Peat as secretary. The Honourable Paul Sauer, Minister of Lands, was duly elected Honorary President, and Honorary Vice-Presidents were found in the persons of the Director of the National Zoological Gardens, Dr. R. Bigalke, the Director of Nature Conservation for the Transvaal, Mr. T. J. Steyn, and the President of the Wild Life Protection Society of South Africa, Mr. N. H. Gilfillan. In 1959 the Association became known as the "Timbavati Private Nature Reserve" after the Timbavati River — "the river that never runs dry". The reserve was then probably the largest private game reserve in the world with an area of more than 300 square miles.

In 1961 the boundary between the Timbavati Nature Reserve and the Kruger National Park was fenced to control foot-and-mouth disease. A decision was then taken to fence the whole block, although regrettably several farms had to be excluded. To-day the fenced area of the Timbavati comprises fifteen farms and portions of farms, and has an area of almost 200 square miles. The fenced portion was proclaimed a Private Nature Reserve in 1962.

The fence between the Kruger Park and the Timbavati proved disastrous for thousands of animals in the severe drought of 1962. For centuries large herds of wildebeest and zebra had trekked westwards during the winter in search of water and grazing and had returned during the spring rains. The newly erected fence prevented this annual move-

Although scarce in the Low Veld, cheetahs are still found in the Timbavati Nature Reserve.

Photo by Dick Reucassel, A.R.P.S.

ment and thousands of animals died of hunger and thirst along the fence.

Topographically the Timbavati is essentially a Low Veld reserve. It is flat and generally featureless. No hills are found with the exception of Volstruiskop, a small hillock on the farm Albatross. The altitude varies from 1000 to 1500 feet above sea-level, and in normal years a rainfall of 15 to 25 inches is expected.

The most pertinent geological feature is the Timbavati River (formerly the Umbabat) which rises a few miles west of the Timbavati Reserve, cuts through the southern sector and then runs across the central portion of the Kruger National Park to become a tributary of the Olifants River. In the northern areas the most prominent watercourses are the Nhlalarumi and its tributary the Sohebele. The Nhlalarumi is itself a tributary of the Olifants. None of these rivers flows except in times of very heavy rainfall. Instead, they provide water for game in the form of numerous picturesque pools.

The vegetation consists of several veld-types. More than half of the reserve is covered by *Combretum* woodland in which the dominant plants are the Red Bush-Willow (*Combretum apiculatum*), the Zulu Bush-Willow (*Combretum suluense*) and the Zeyher's Bush-Willow (*Combretum zeyheri*). Other important trees in this veld-type are the Silver Terminalia (*Terminalia sericea*), Marula (*Sclerocarya birrea*), Mbandu (*Lonchocarpus capassa*), Tree Wistaria (*Bolusanthus speciosus*), Bakhout (*Lannea discolor*), Kiaat (*Pterocarpus spp.*), Corkwood (*Commiphora spp.*) Buffalo-Thorn (*Ziziphus mucronata*), African Wattle (*Peltophorum afri-*

canum) and Wild Pear (*Dombeya rotundifolia*). The main grasses in this vegetation type are the Finger Grasses (*Digitaria spp.*), Herring-bone Grass (*Pogonarthria squarrosa*), Red Oat Grass (*Themeda triandra*) and Buffalo Grass (*Panicum spp.*).

The second most important veld-type is *Acacia nigrescens* woodland savanna. In the southern parts of the reserve this veld-type is found on the heavy black clay soils of a dolerite dyke. In the northern areas it characterizes dark soils which are mainly transition types between dolerite and granite.

The characteristic plant is the Knobthorn (*Acacia nigrescens*) with its very characteristic projections on the trunk. It is found in both tree and shrub form, the former often reaching heights of more than thirty feet. The Knobthorn is practically always associated with the Marula (*Sclerocarya birrea*) in this veld-type. Other prominent woody plants are the Leadwood (*Combretum imberbe*), Albizzia (*Albizzia harveyi*), Mbandu (*Lonchocarpus capassa*) and the Torchwood (*Balanites maughamii*). The most conspicuous grasses are *Setaria* and *Panicum* species, both of which are much favoured by game.

In the northern parts of the Timbavati are found extensive areas of Mopani woodland, the dominant plant being the well-known Mopani (*Colophospermum mopane*) with its typical double leaf. Both the scrub and tree forms are found. Mopani favours the brackish soils and is commonly found growing along gullies and washes.

Some of the most beautiful trees in the Low Veld are found along the banks of the larger watercourses. The most common is the Transvaal Ebony (*Diospyros mespiliformis*) with its dark-green foliage. Rivalling it as a provider of shade are the Natal Mahogany (*Trichilia roka*) and the Nyala Tree (*Pseudocadia zambesiaca*). Other moisture-loving trees found in the reserve include Matumie (*Adina microcephala var. galpinii*), Mbandu (*Lonchocarpus capassa*) and the Wild Fig (*Ficus sycomorus*). The ubiquitous reed (*Phragmites communis*) and the Wild Date-Palm (*Phoenix reclinata*) are found along practically every river and stream.

The Transvaal Low Veld has undergone astonishing changes during recent years. Agriculture has laid claim to more and more land, and industry with its attendant development and social expansion has now appeared. Natural veld with its fauna and flora is fast disappearing, and few places remain where game can enjoy unrestricted freedom as in centuries past. The Timbavati now assumes a vital role in modern nature conservation for much of it is undisturbed. It represents a vignette of the old Low Veld.

Most of the indigenous game animals are still in the reserve. The common antelope such as Impala (*Aepyceros melampus, melampus*), Blue Wildebeest (*Connochaetes taurinus taurinus*), Grey Duiker (*Sylvicapra grimmia caffra*), Steenbok (*Raphicerus campestris zuluensis*) and Kudu (*Tragelaphus strepsiceros strepsiceros*) abound in most parts of the reserve. Equally abundant are Giraffe (*Giraffa camelopardalis wardi*), Zebra (*Equus burchelli antiquorum*), Waterbuck (*Kobus ellipsiprymnus*), which frequent the watercourses and vicinity of dams, and Bushbuck (*Tragelaphus scriptus sylvaticus*) common though rarely seen, which choose the dense scrub and undergrowth. Both types of indigenous pig, viz. the Warthog (*Phacochoerus aethiopicus*) and the Bushpig (*Potamachoerus porcus mashona*) are found in the area.

Long years of drought have taken their toll of several game species. Chief to suffer has been the Roan Antelope (*Hippotragus equinus equinus*) which is now extinct in this reserve. Other species brought close to the verge of extinction are Sable (*Hippotragus niger niger*), Tsessebe (*Damaliscus lunatus lunatus*), Reedbuck (*Redunca arundinum arundinum*) and Ostrich (*Struthio camelus*). Low Veld types which are not represented in the Timbavati include both types of rhinoceros (*Diceros bicornis bicornis* and *Diceros simus simus*), Hippopotamus (*Hippopotamus amphibius*), Oribi (*Ourebia ourebi*), Nyala (*Tragelaphus angasi*) and Eland (*Taurotragus oryx*).

Elephants (*Loxodonta africana africana*) are often encountered in the block. The majority wander across from the adjacent Kruger National Park paying little attention to the intervening fence. A few old bulls appear to have taken up permanent residence in the block.

All the carnivorous species, with the possible exception of Wild Dog (*Lycaon pictus pictus*), occur in the block. Lions (*Panthera leo krugeri*) are common along the Timbavati River and virtually no evening goes by without the grunting and roaring of these majestic cats. Leopards (*Panthera pardus*) are common but rarely seen. Cheetah (*Acinonyx jubatus jubatus*) are not as numerous as in earlier times but are sometimes seen in the southern areas. The carrion-eaters, most important in the ecology of the Reserve, are common. These include the Spotted Hyaena (*Crocuta crocuta*), the Saddle-backed Jackal (*Canis mesomelus mesomelas*) and the Side-striped Jackal (*Canis adustus adustus*).

Primates are well represented in the Reserve. Baboons (*Papio ursinus orientalis*) are ubiquitous and not always popular with owners who take pride in the appearance of their rest-camps! Vervet Monkeys (*Cercopithecus aethiops cloetei*) are found everywhere.

Amongst the feathered fauna of the Timbavati one notes a predomi-

A wandering elephant bull pauses for a bathe in a large dam in the Timbavati Nature Reserve.

Photo by S. M. Hirst.

nance of game and predatory birds over the small seed-eaters. Guinea-fowl (*Numida meleagris*), Swainson's Francolins (*Pternistis swainsoni*) and African quail (*Coturnix coturnix*) are very common. The skies are rarely empty, and one need not look far for the solitary roving eagle, kite or other predatory birds.

Several species of vulture frequent the area, and it is a common sight to see them circling above a freshly killed carcass. Despite their excellent vision which enables them to detect a carcass at a considerable distance, they are frequently beaten to it by the watchful Bateleur (*Terathopius ecaudatus*).

Several of the older dams in the Reserve provide sanctuary for water-birds. Common types found include the Spurwing Goose (*Plectropterus gambensis*), the Knob-billed Duck (*Sarkidiornis melantos*) and the diminutive African Grebe (*Podiceps cristatus*).

Although the Timbavati Nature Reserve is to-day maintained purely as a sanctuary for wildlife, previous agricultural exploitation has left some scars. In the southern areas previous occupation by Bantu squatters resulted in overgrazing and inadvertent burning of the veld. These areas are to-day heavily bush encroached. A similar situation prevails on some western farms due to previous use by European cattle. Cattle are now prohibited in the fenced area.

Development to-day consists mainly of dam building. More than thirty water-points and catchment dams are spread over the sixty thousand morgen Reserve. Owners have spared no expense in providing water for game. Most owners have erected rustic and charming rest-camps in scenic spots, and a network of roads and tracks ensures access to most parts of the Reserve for both the warden and the owners.

The Timbavati to-day faces a challenge from changing conditions. The game fence surrounding the Reserve has put an end to mass movements of game. A combination of drought, overgrazing and veld burning has led to a marked reduction in carrying capacity in some parts. Some species, notably sable and tsessebe, are on the verge of extinction.

In 1963 a long-term ecological study of the Reserve was initiated by the Division of Nature Conservation of the Transvaal. This study aims at providing the basic information on which the owners can base a management policy, and which will assist them in correct habitat improvement, veld and soil conservation and population control where necessary.

The Low Veld has many facets. Some of these have been lost forever because of man's need to advance. As the advancement continues, areas such as the Timbavati will acquire a greater aesthetic value. The hope is that by a combination of sentiment and science it will do just that and become not only an asset to the Province but also a show-piece for the nation.

Grateful acknowledgements are due to Mr. D. D. Reucassel for providing the accompanying photographs of wildlife in the Timbavati Private Nature Reserve.

Meat production of South African Game Animals

2. THE AFRICAN BUFFALO

J. H. M. van Zyl and D. M. Skead

THIS study of the meat production of an 8½ year old African Buffalo (*Syncerus caffer*) follows on the one made of the Eland (*Taurotragus oryx* (5)). Published information on the body statistics is limited to a few weights and certain body measurements. The rinderpest epidemic of 1896-1899 drastically reduced the number of buffaloes in South Africa. But the fact that two small herds of 30 and 40 animals respectively increased to 200 and 400 during a 16 year period from 1896 onwards, shows that this species has a capacity for rapid reproduction (4). Because of the animal's size (± 1500 lbs.), its adaptability, immunity to certain cattle diseases, the good quality of its meat (dealt with later) and its great popularity among hunters, it could become an important source of animal protein for the nation.

The present study is based on an African Buffalo bull that was caught during the autumn of 1956 in Moçambique and brought to the S.A. Lombard Nature Reserve when about one month old. It was slaughtered on 24th August 1964 at the age of about 100 months. The animal was probably sterile, as the testes were under-developed. Apart from this, it was well developed and very aggressive like others of its kind. With proper care it could be caught in a crush and led by the nose with a bull leader. It was possible to lead the buffalo onto a weighbridge in this manner.

The buffalo was fed on concentrates, mainly dry ground lucerne and maize meal supplemented by a cattle lick in solid form. Green fodder in the form of lucerne and oats were fed in sufficient quantities. It was kept in a small camp.

The buffalo was shot through the forehead and immediately hung up by the hindlegs; it was bled by cutting the veins and arteries in the neck. The oesophagus was tied off.

The following figures show how this buffalo gained weight in the S.A. Lombard Nature Reserve as it got older:-

Age in years	*Weight in lbs.*
1	477
3	1091
5	1509
8	1501

It is clear that the maximum weight was attained at the age of five years. But at times it was in a better condition between the 5th and 8th years than at the time of slaughtering. It may, therefore, be presumed that a buffalo in good condition would weigh well over 1500 lbs.

In the present study the methods of taking weights and measurements of animals follow those of Ledger (1963). No measurements of the horns can be given, as the animal had previously been dehorned. The hoof measurements are given separately, since they vary with the physical condition of the habitat's soil and possibly also with the animal's age.

The body measurements of this animal are as follows:-

TABLE 1

Body Measurements of an African Buffalo in the S.A. Lombard Nature Reserve

Length of ear	10″	
Length of head	30″	
Length of body	73½″	
Length of tail	33¼″	
Total length	136¾″	
Length of hindleg	24¼″	(Length of hoof—4⅛″)
Length of hindfoot	8¾″	
Shoulder height	61¼″	(Length of hoof—4¼″)
Height of hindleg (at the croup)	58¼″	
Length of hindleg (at thigh articulation)	35¾″	
Breast girth	92″	

The body measurements correspond well with the following published by Roberts (1951) and Sclater (1900):-

	Length of head and body	*Shoulder height*
Roberts (2)	96″	65″
Sclater (3)	190″	59″
SALNR	103½″	61¼″ (excluding hoof)

SALNR = S.A. Lombard Nature Reserve.

It may be assumed, therefore, that the present study is based on a specimen of average proportions for its kind.

The following table gives the weights and measurements of the offal:-

TABLE 2

Weights and Measurements of Offal of an African Buffalo in the S.A. Lombard Nature Reserve

1. Blood weight		51 lbs	3 ozs
2. External offal:-			
(a) Head (unskinned with tongue)		99 lbs	8 ozs
(b) Skin		135 lbs	10 ozs
(c) Tail		2 lbs	12 ozs
(d) Unskinned feet		28 lbs	11 ozs
3. Internal offal:-			
(a) Heart		9 lbs	1 oz
(b) Lungs		17 lbs	2 ozs
(c) Liver (with gall-bladder)		18 lbs	
(d) Gall-bladder:-	(i) full		10.9 oz
	(ii) empty		2.6 ozs
(c) Oesophagus:-	(i) full	3 lbs	12 ozs
	(ii) empty	2 lbs	7 ozs

(f) Stomach:-	(i) full, with fat	188 lbs	14 ozs
	(ii) fat only	25 lbs	
	(iii) Rumen (full)	138 lbs	15 ozs
	(iv) Rumen (empty)	27 lbs	12 ozs
	(v) Reticulm (full)	2 lbs	14 ozs
	(vi) Reticulm (empty)	2 lbs	1 oz
	(vii) Omasum (full)	11 lbs	12 ozs
	(viii) Omasum (empty)	4 lbs	6 ozs
	(ix) Abomasum (full)	9 lbs	9 ozs
	(x) Abomasum (empty)	3 lbs	6 ozs
(g) Intestines:-	Full, with fat	46 lbs	11 ozs
	(ii) Fat only	7 lbs	
	(iii) Small intestine (full)	20 lbs	9 ozs
	(iv) Small intestine (empty)	12 lbs	14 ozs
	(v) Large intestine (full)	19 lbs	2 ozs
	(vi) Large intestine (empty)	9 lbs	
(h) Length of:-	(i) Small intestine	90 ft.	
	(ii) Large intestine	30 ft.	10 ins
(i) Kidney:-	(i) Left with fat	2 lbs	10 ozs
	(ii) Fat only	1 lb	8 ozs
	(iii) Right, with fat	3 lbs	6 ozs
	(iv) Fat only	1 lb	10 ozs
(j) Spleen		4 lbs	10 ozs
(k) Reproductive organs (including bladder)		4 lbs	4 ozs
Total weight of internal and external offal + kidneys + reproductive organs		616 lbs	2 ozs

As already established, an appreciable loss in weight occurs during slaughtering (5) amounting to 4.2% in the case of the buffalo. This is a variable factor, but since the present study was made under the same conditions and in the same season as that of the Eland (5), a somewhat greater loss could be expected for the buffalo since more time was spent on the larger carcase.

According to Table 2, 41% of the total weight was made up of offal, of which the alimentary tract and its contents (calculated on total weight) represented 15.9%. The latter's fat comprised 17.5% (calculated on total weight of alimentary tract). The contents of the whole alimentary tract amounted to 60.7% of the tract's total weight, and to 9.6% of the animal's total body weight. This may possibly represent the maximum capacity for the buffalo, as it had ample food up to the time of slaughtering.

Another interesting aspect was that the alimentary tract (full and without fat) amounted to only 13.1% of the total carcase yield, which was 55.2% in the present study. Ledger (1963) found that in the case of both game and cattle with a carcase yield of 58%, the full fat free alimentary tract amounted to 20%. According to the above author it is to be expected that game living frequently on inferior plant material would have a higher digestive content for the corresponding carcase yield. But it is concluded that game have a faster rate of food turnover. The present study supports this conclusion, since the buffalo was fed on concentrates and hence was expected to have a lower digestive content.

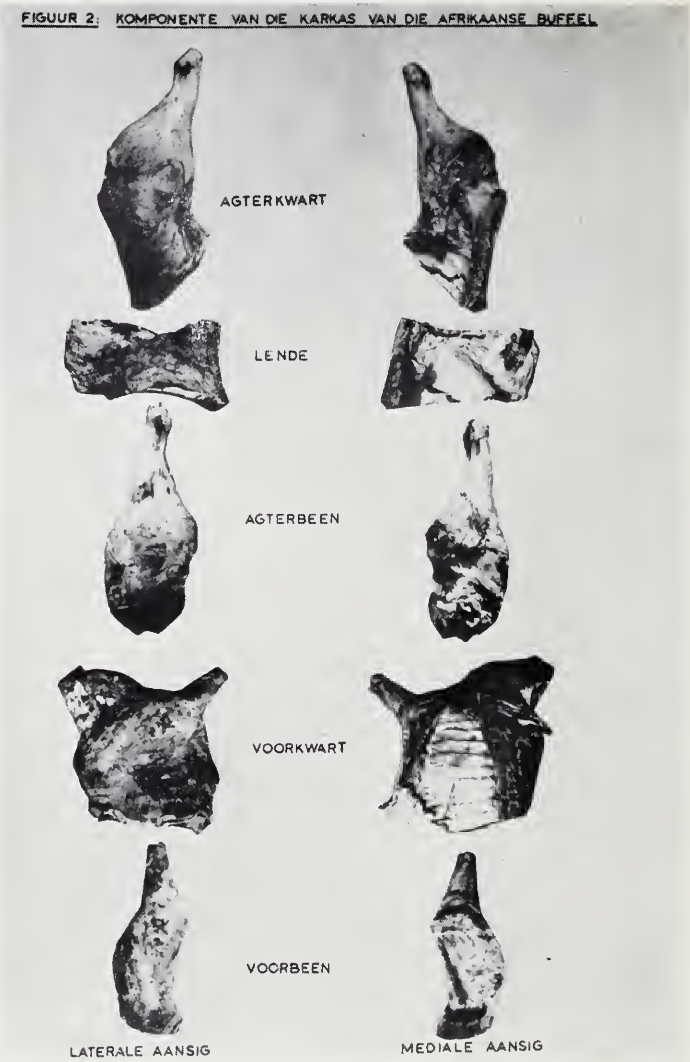
The length of the alimentary tract (excluding the stomach and oesophagus) is more than 120 ft. (Table 2). The ratio of the large intestine to the small intestine in the buffalo is 1:3 and thus, according to Ledger (1963), is somewhat smaller in cattle in which it is 1:3.5.

The weight of the kidney fat shows a slight difference, but the kidneys themselves show a marked difference in weight, the right kidney being 12 ounces heavier than the left.

The blood weight amounted to 6.2% of the carcase weight, while it is 5.8% in the Eland (5).

The wet hide is particularly thick (between ½″ and ¾″) and amounts to 9% of the total body weight.

1. Carcase of the African Buffalo. Lateral View. Medial View.



2. Carcase components of the African Buffalo. (From the top downwards) :—

Hindquarter
Loin
Hindleg
Forequarter
Foreleg
Lateral View. Medial View

Photos by I. M. Prinsloo.

After the skin of the four limbs, the neck and the tail had been cut off, a thong was cut in one length all around the edge of the buffalo's skin. This thong was cured and then found to be 426 ft. in length (± ½ inch thick) and to weigh 67½ lbs.

Although a butcher judged the carcase to be grade III, it appeared to have a high carcase yield (Table 3). The meat has a pleasing odour, and there was no noticeable difference between it and that of beef. It is of a reddish-brown colour, more or less like that of beef. The texture appeared to be fine and when prepared was no coarser than beef. Parts of the hump and brisket were prepared in different ways. When cooked in water it became dark-brown in colour like that of most other species of game and was tough. But when this meat was first cooked in a pressure cooker and then roasted in oil, it was particularly crisp, tender and very tasty. The raw meat certainly has no unpleasant odour. The tail was cooked in a pressure cooker until tender and then roasted in oil; it compares favourably with the most tasty ox-tail.

The meat production of the African Buffalo is as follows:-

TABLE 3

Carcase Weights of an African Buffalo in the S.A. Lombard Nature Reserve

1. Weight on hoof	1501 lbs 6 ozs
2. Dressed carcase	828 lbs 7 ozs (hump included)
3. Components of carcase	
(a) Left side	403 lbs 7 ozs (hump not included)
(b) Right side	398 lbs 15 ozs (hump not included)
(c) Hump	26 lbs 1 oz
(d) Forequarter	236 lbs 4 oz
(i) Foreleg	77 lbs 3 ozs
(ii) Neck and thorax	159 lbs 1 oz
(e) Hindquarter	159 lbs 6 ozs
(i) Loin and flank	73 lbs 14 ozs
(ii) Hindleg	85 lbs 7 ozs
(f) Fat of right side	23 lbs 2 ozs
(i) Subcutaneous	7 lbs 9 ozs
(ii) Intramuscular	10 lbs 9 ozs
(iii) Cod	5 lbs 0 ozs
(g) Lean (muscles, excluding intramuscular fat, bone and tendons)	266 lbs 1 oz (right side only)
(h) Butcher's bone and tendons	205 lbs 8 ozs
(i) True bone	138 lbs 4 ozs
(j) Biltong meat	311 lbs 4 ozs
(k) Rest of meat	293 lbs 7 ozs
(l) Loss of moisture, etc. during the slaughtering process	62 lbs 13 ozs

It is evident from the grading that the buffalo was not fat (following standard judging in domestic stock); its condition may be described as fair judging by its condition prior to slaughtering.

Ledger (1963) found that lean game animals gave a carcase yield between 50% and 60%. According to this author a lean steer (*Bos indicus*) gave 15% carcase fat and a meat yield of 52%. It is remarkable that the buffalo with a carcase fat percentage of 6% gave a carcase yield of 55.2% (Table 3) compared with 59% for the Eland (5), while a very fat steer with a fat yield of 40% gave a carcase yield of only 62%. Ledger (1963) found that 19% of game animals (in their natural habitat) gave a carcase fat yield of more than 5%; it is surprising that the buffalo, under favourable conditions, yielded only 6% fat.

In the case of the edible part of the carcase (fat and lean) calculated on carcase weight, the buffalo gave a yield of 76.2% compared with 82% in the Eland (5). Ledger (1963) reported that the yield of certain game species and steers was between 84% and 86%. It must be mentioned, however, that a considerable loss of moisture took place during the long period of dissecting the carcase into its different component parts of bone, lean meat and fat (Table 3). The total lean meat (i.e. biltong and rest of meat — Table 3), which was accurately determined and calculated on the total live weight, was found to be 41.2% of the animal. According to Ledger (1963) this ratio is constant in all game animals and ranges between 41% and 46% according to the species, whereas it is 32% in the case of a steer (*Bos indicus*).

The forequarter was markedly heavier than the hindquarter (Table 3). Ledger (1963) showed that the forequarter was always heavier than the hindquarter in mature male game animals. The lean yield of the hindquarter calculated on the carcase weight was just under 40% for the buffalo, while Ledger (1963) found that adult male Kobs (*Adenota kob thomsonii*) and Blue Wildebeeste (*Gorgon taurinus*) yielded 52.5% and 46.7% respectively. But the latter author found that the hindquarters of game in the case of mature and immature females had a yield of more than 60% in some cases, whereas the highest yield for steers was seldom more than 54%.

From the data in Table 3 it is clear that the wet biltong comprises 37.5% of the dressed carcase. The Eland (5) had a somewhat higher yield (42.6%), but the buffalo's hump is not included in the biltong in this study.

The "true bone" of the dressed carcase amounts to 16.7% whereas it is 18% for the Eland (5).

Further work on the meat production of game is being done in the S.A. Lombard Nature Reserve.

Acknowledgements

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Springbok Angler Bill Saltmarsh, 1897-1957

S. S. du Plessis

WHILE his two grandchildren were playing in the garden, his daughter Jean and I were sitting on the verandah of her home talking about Bill Saltmarsh's life. She told me how fond he was of taking children out to fish, playing "ghillie" for them, and then sharing their great joy when a fish was on the hook.

Bill was no ordinary angler but one of that rare type that took to angling not only for pleasure, but because he looked upon it as an amateur sport that made the greatest demands upon sportsmanship and technical ability. Instead of merely casting his hook and waiting for luck, he preferred to rely on his knowledge of the habits of fish and tried to outwit them by applying his experience of angling techniques and always using the lightest possible fishing-tackle.

But Bill Saltmarsh's fame as an angler has nothing to do with the number of blue kurpers that he pulled out of Hartbeespoortdam: the "Queen's Coronation Medal" awarded to him in 1953 was for services rendered to the community in an honorary capacity in connection with fisheries and angling administration. He was one of the pioneers of organized angling in South Africa. At an early stage he realized that angling sport was a valuable resource, and that anglers themselves would have to ensure that its exploitation was not endangered. He tried to achieve this and also to protect the interests of anglers, but he realized that unless anglers organized themselves nothing would be achieved.

He was closely associated with the founding and administration of so many angling societies that these are best cited in the form of a list:

Co-founder of:
  First South African Sea Anglers' Association, 1932.
  Northern Transvaal Anglers' Union, 1934.
  Transvaal Anglers' Union, 1948.
  South African Anglers' Union, 1950.

Honorary President:
  South African Anglers' Union, 1956.

Honorary Vice-president:
  Daggafontein Angling Club, 1956-57.
  Rooidag Angling Club, 1947-57.

Honorary member:
  Iscor Angling Club, 1953-57.
  Pretoria and District Angling Society, 1947-57.
  Pretoria Municipal Angling Club, 1953-57.
  Buenos Aires Rod & Gun Club, Argentine, 1956-57.

Life member:
  Pretoria Railway Angling Society, 1948-57.

Foundation Member:
Transvaal Inland Fisheries Advisory Board, 1944-49.
  Transvaal's Fauna & Flora Advisory Board, 1950-57.

In the Transvaal Province he devoted himself particularly to the interests of the Transvaal Anglers' Union. As a member of the Fauna & Flora Advisory Board he was for years the most important link between Transvaal's Nature Conservation Branch and thousands of organized anglers.

William Edward Saltmarsh was born on the 23rd January, 1897, in London, whence his family came to East London in the year 1902.

Bill Saltmarsh with two kurpers *Tilapia mossambica.*

There he caught his first big fish in 1906 when he was only nine years old.

In 1910 the family moved to Pretoria, where Bill lived for the rest of his life. He was educated at Selborne College in East London and the Old Gymnasium School in Pretoria.

After he had served his apprenticeship with Pretoria Engineers Ltd., he assumed duty in the Mechanical Workshops of the South African Railways in 1920 where he remained in service until he retired on pension on the 23rd January, 1957.

In 1930 he married Miss Dorothy Munsie of Krugersdorp, and one daughter Jean (now Mrs. Kevan Napier) was born of the marriage.

Bill could also look back upon an honourable motor driving career. In 1914 he learned to drive the $1\frac{1}{2}$ ton solid tyred Dennis buses of Gezina Motor Buses (owned by Mr. W. McVittie). He also did much special driving for Sir Julius Jeppe and Sir Abe Bailey.

During the First World War he was on service in East Africa in the capacity of Staff Sergeant Mechanical Instructor. Throughout his lifetime he was never involved in a motor accident, and in 1952 the Road Safety Association awarded him a veteran motor driver's certificate.

While on military service he learned to know the Cape Coloureds very well and was so charmed by these cheerful people that he made a study

The British Empire team that competed in the International Tuna Cup Match at Wedgeport, Nova Scotia, in September, 1953.

Front row (from left to right): Maj. Cyril H. Frisby, V.C. England (captain), Bill Saltmarsh, S. Africa; W. Eugene Meyer, Bermuda.

Back row (from left to right): Harry Truran, Bermuda; Commander Duncan Hodgson, Canada and Don Henley, Canada.

Photo: Nova Scotia Bureau of Information.

of their songs, accent and mannerisms. He was fond of entertaining his friends around camp-fires with songs and sketches of the Cape Coloureds.

He was a sincere Christian and fond of singing. From the year 1920 up to the time of his death he was a member of the St. Albans' Cathedral Choir and St. Hilda's Church Choir. During the years 1925 to 1932 he was also a member of the well-known Pretoria Male Choir.

For years the Saltmarsh family lived in Gezina, Pretoria, in a house that Bill built with his own hands before he was married. On the back verandah he had his "angler's den" where anglers were always welcome. Here he took pride in showing his collection of fishing-tackle and could discuss fish for hours at a time. But strangely enough I never heard him relate typical angling stories. Here he also had his desk, where he corresponded with anglers all over the globe, and where he also wrote the angling column for the "Pretoria News" for more than twenty years.

Although he was also an enthusiastic shark and big fish angler, his favourite fish was the Blue Kurper (*Tilapia mossambica*). He could become quite lyrical about this fish and did in fact develop kurper angling into a fine art.

Nearly every week-end was spent angling. His favourite spot for kurper was Schoeman's farm on the Hartbeespoort Dam, and in the case of trout he preferred a beautiful part of the Crocodile River at Donkerhoek. For many years he spent his annual angler's holiday at the Bashee River mouth in the Transkei. It was here that he gained the experience that made him a Springbok angler. He attached special importance to the absence of class distinctions at angling waters and often used to say "kings and beggars fish side by side without any discrimination".

On his last angling trip to Otto's Dam at Draaikraal he was after trout in the company of two old angling friends, Ranny Tatlow and Gordon Potter. It was here that he became ill, never to recover.

The greatest honour that an angler can wish for fell to his lot when he became a Springbok angler. In September 1953 he represented South Africa in the British Empire team which participated in the International Tuna Cup Match at Wedgeport, Nova Scotia.

After his retirement in 1957 Bill remained in Pretoria with the intention of devoting all his time to angling affairs. Unfortunately he passed away on the 3rd December, 1957, after a short illness.

In the library of the Provincial Fisheries Institute at Lydenburg there is a modest memento of his work in the interests of angling. It is the trout rod with which he caught his last fish with his portrait beneath it.

The Legal Status of Game Animals in the United States of America, Great Britain, Germany and South Africa

Dr. R. Bigalke

1. GENERAL

In the far distant dawn of human history man and all other living things found on the earth's surface, the wild animals and wild plants, formed a vast complex in which one was no more dominant than the other. The things that were common property (*res communes*) were air, the water of rivers, the sea and its shores, the wild animals (*ferae naturae*) and the wild plants. Man's relation to these things of nature presented problems long before the dawn of civilization. In communal groups of the most primitive peoples, natural objects were segregated and received special attention for such qualities as were useful to man.

As man through the course of millenia gradually learned to tame and finally domesticate certain kinds of wild animals, and to raise food from plants that he cultivated, game animals and fish became objects of sport for the rulers.

For legal purposes all animals may be classified in two groups:-

(a) Domesticated animals.

(b) *Ferae naturae*, i.e. wild or non-domesticated animals.

We are concerned only with group (b).

2. UNITED STATES OF AMERICA

(a) Ferae Naturae

Ferae naturae include both fish and game. In general "game" means the mammals and birds of a wild nature obtained by fowling and hunting. "Fish" in its broadest sense is a designation for any kind of aquatic animal. This concept of fish is, of course, a legal and not a zoological one.

It is important to note that legally all animals wild by nature are *ferae naturae*. The decisive consideration is the *status of the species*, not whether any individual animal is wild or captive. Thus in the U.S.A. deer are *ferae naturae* even when raised in captivity or when they are offspring of captive deer.

(b) State Ownership

Wild animals that are common property (*res communes*) actually belong to nobody (for this reason they are termed *res nullius* in South Africa). The ownership of other resources goes with the land, and it devolves upon the landowner to preserve or destroy them as he may deem fit (it is not clear whether this also applies to wild plants). This does not, however, apply to wild animals. The American concept is that the *ownership of wild animals, so far as they are capable of ownership, is in the State, "not as proprietor, but in its sovereign capacity, as the representative, and for the benefit of all its people in common"* (Connery). Hence the State holds the wild animals in trust for its people. It follows, therefore, that an individual cannot obtain an absolute property right to game except under such conditions, restrictions and reservations as the state may impose. The object of the concept of common property is to prevent the few that are favourably situated from reaping the benefit of game to the exclusion of those handicapped by distance or other considerations.

Provided game has been obtained legally, actual possession thereof is possible only in one of two ways:-

(1) Possession through capture and subsequent confinement.
(2) Possession after it has been killed.

If a wild animal temporarily confined escapes, the right of possession is lost. But even in such cases property therein continues, provided it can be shown that the animal has become sufficiently tame so that it will return of its own accord. This is, of course, very difficult to establish. If wild animals escape from a circus or zoo and it seems that they will not return, the owner's right of property continues to apply if they are within a reasonable distance. But the principle is vague, and the most that can be said is that the American courts have tended to hold that wild animals that escape from actual possession after long confinement but remain in the near neighbourhood are still the property of their former possessor. Property in *domesticated animals* continues wherever they stray. It appears, too, that if a wild animal escapes from captivity and pursuit is abandoned, it reverts to the status of *ferae naturae*. Unless the animal clearly shows evidence of ownership, it may subsequently become the property of another captor.

Generally speaking animals that have reverted to the wild state and thus become feral are considered to have assumed the status of *ferae naturae* again. In the U.S.A. the Mute Swan (*Cygnus olor*) is an example.

(c) Police Power

Another ground in support of the State's right to impose regulations governing the hunting of wild animals is its police power. This empowers the State to legislate for the health, safety, morality and welfare of the people. The American courts have held that the police power alone is a sufficient basis for all regulatory powers the various states excercise over game, in the same way as they do over domesticated animals.

As the game belongs to all people and is a valuable source of food, the State, which is sovereign by virtue of its police power, regulates the taking of game for the benefit of all.

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3. GERMAN FEDERAL REPUBLIC (WEST GERMANY)

In the German Federal Republic wild animals are "herrenlos" (that is to say nobody's property or *res nullius* in South African legal terminology) as long as they occur free in nature. This does not, however, apply to wild animals in zoological gardens, small fenced areas, breeding-farms and the like, nor to fishes in ponds or other impounded private waters.

Ownership of a "herrenlos" object with the inherent power of mobility is obtained by taking possession of it, provided acquisition is not prohibited by law and does not violate another person's rights. Seizure of a wild animal with a view to exercising ownership over it is, of course, only possible in one of two ways, namely either by hunting or capturing it alive. Until one of these actions has been carried out, there is no ownership of the animal. Poachers are excluded from the provision of ownership.

If a wild animal in captivity regains its liberty, it again becomes "herrenlos", unless it is immediately pursued by the owner or when he ceases to pursue it. A tamed animal also becomes "herrenlos" when it ceases to return to its domicile.

Domesticated animals are considered to be tame and not tamed animals.

In the year 1848 important new concepts were introduced into the German game-laws. Of special importance was the principle that hunting was inseparably linked with ownership of the land. Provision was, however, made for the letting of hunting-rights.

The wild animals that are classified as game are various kinds of mammals and birds listed in the "Bundesjagdgesetz vom 29 November 1952" (Federal Game Law of 29 November 1952). It should be noted that there are variations in the hunting regulations in the different states of West Germany.

In the German Federal Republic hunting is a specialized activity with a strict code. It is incumbent upon the persons entitled to hunt to practise game conservation so as to ensure that no species is exterminated. The only exception is when the destruction of game is necessary to control an epizootic among the animals.

Before a hunting permit is issued to an applicant, he must have passed a hunting examination showing that he has adequate knowledge of the game animals and the game laws, the handling of weapons and the treatment of the dead game.

4. GERMAN DEMOCRATIC REPUBLIC (EAST GERMANY)

In the "Deutsche Demokratische Republik" and in East Berlin all game animals are the *property of the nation*. This is in accordance with the different standards that prevail in communistic countries.

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5. REPUBLIC OF SOUTH AFRICA

In Roman-Dutch law, which is the legal system of the Republic of South Africa, game animals are classified as no one's property (*res nullius*). Hence they have no owner until someone takes lawful possession of them either by hunting or capturing them.

In the earliest period of human history, the wild animals in the sea or other waters, the air or on the land could be captured or killed and owned by everyone. This was a common right exercised by everybody, rich or poor. With the advance of civilization the control of hunting and fowling came by common consent to devolve upon the government, or upon those to whom the protection of the community was entrusted. The logical standpoint was that game could not be allowed to be possessed or acquired by particular individuals only.

Things that belong to nobody may be brought into possession of some one by means of certain acts. Such things are wild animals like mammals, birds and fish and others with which we are not concerned. These may be acquired by a person in one of several ways, namely by hunting, fowling or fishing or by capturing them alive. The law makes a logical and obvious distinction between domesticated animals that can be controlled by man and wild animals that cannot be controlled. In the earliest periods of man's existence on earth, there were no domesticated animals and he was entirely dependent upon wild animals as a source of meat. But in course of time man first tamed some species of wild animals and eventually domesticated them, thereby making them completely subservient to himself.

There seems to be some doubt about the status of tamed wild animals that escape and do not return to confinement. Some maintain that they do not revert to natural liberty (that is do not again become *ferae naturae*) but remain in private ownership.

Because game animals are *res nullius* in South African law, the Republic's constitution authorises the Provinces to make ordinances which lay down the conditions, restrictions and reservations under which an individual obtains an absolute property right to game (Republic of South Africa Constitution Act 1961, paragraph 84 (j)). The legal position is the same as that obtaining in the United States of America, that is to say the Provinces are not the proprietors of game animals but hold them in trust for the nation. To ensure their wise use, the Provincial Councils regulate the taking and capturing of game animals by means of ordinances.

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6. GREAT BRITAIN

According to the common law of England and Scotland, following that of Rome, wild animals in a state of nature are common to mankind. But it was recognised at an early stage that the free right of hunting was incompatible with the preservation of game in such numbers as to afford ample sport for the monarch and the nobles. This led to the enactment of a series of laws setting apart certain districts for the sport of the sovereign and those to whom he gave lands or tenements. As the population grew, it became necessary to protect game *outside* the royal hunting areas if it was not to disappear. This led to the enactment of game-laws.

Although there is no private ownership of wild animals, the proprietor of the sporting rights in England and the landowner in Scotland have the exclusive right to take possession of any wild animals (*ferae naturae*) including game that may be on their land from time to time. They have no property right to the animals until they take them into physical possession (that is alive or dead).

The occupier of the land need not necessarily be in possession of the sporting rights, since the landowner may have let the land to a tenant but reserved the sporting rights to himself. On the other hand a landowner, though occupying his land, may let the sporting rights to a shooting tenant.

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7. GAME OWNERSHIP

In the aforegoing the legal status of game animals has been outlined in two of the oldest and most highly civilized states in Europe (Britain and West Germany), in the leading state on the American continent (United States of America) and in the most highly civilized state in Africa (the Republic of South Africa). Although there are slight differences, in none of these instances is the legal status of the game such that it is the absolute property of the landowner or occupier. *Nor is the state* (with the exception of communist East Germany) *the proprietor; it controls the use of this renewable resource in the interests of the people.* Hence an individual cannot obtain an absolute property right to game animals except under such conditions, restrictions and reservations as the state imposes by means of legislation. In the Republic the game laws are a function of the various provinces (The Republic of South Africa Constitution Act, 1961, section 84 (j)).

It is a wise provision of South African law that absolute ownership of game animals cannot be granted to the landowner or farmer, because he cannot exercise physical control over the game (including the fish of the oceans, rivers and lakes) as he can well do in the case of domesticated animals.

In South Africa, as in other cases, the state holds the wild animals in trust for its people.

8. IMPLICATIONS OF PERSONAL PROPERTY RIGHT TO WILD ANIMALS

The following are some of the implications that would follow if game animals were legally the absolute property of the landowner or farmer:-

(a) In the case of domesticated animals the owner either brands or tags or rings them in such a manner that he can prove ownership in a court of law. This is not possible in the case of game animals, not even with the modern methods of immobilizing antelopes by means of dart-guns. This method is laborious and expensive and would have to be applied annually in order to mark the natural increase.

(b) Where game is still plentiful, as in the Transvaal low veld, most farms are still unfenced. Hence landowners cannot control the animals' movements from one farm to another. Even where farms are fenced with ordinary stock-fences, the movements of game from farm to farm are difficult to control.

(c) If a game mammal could be satisfactorily branded or marked and were the absolute property of the landowner or occupier, various problems would arise. Thus if branded impalas moved from A's farm to that of B and caused damage on the latter, either to fences or otherwise, B would be able to claim damage in a court of law. This might result in endless litigation between neighbours. Even if B could capture the animals concerned, he could not impound them as he could do in the case of stray domesticated animals. Special provision would have to be made for impounding wild antelopes.

(d) There is an ever-present danger that game mammals would be eradicated by unscrupulous persons. By means of strategically placed water-points, fields of green fodder or burned areas, the game of a particular area could be destroyed to the detriment of others.

(e) Absolute ownership of game would probably result in unbridled land speculation in those parts of the Transvaal Province where game is still plentiful.

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A Modjadji cycad

FAUNA & FLORA

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The opinions expressed in this bulletin are not necessarily those of the Nature Conservation Branch nor of the Administration

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ADMINISTRATION OF THE PROVINCE OF TRANSVAAL

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NOTES FOR READERS

1. Owing to the former lack of an editor, the publication of the *Fauna and Flora* Bulletins has been somewhat in arrear. The publication of this number brings the year of publication up to date.

2. The outside front cover page designed by our artist, Mr. Louis Steyn, shows the Provincial mammal, the Impala (*Aepyceros melampus*), the Provincial bird, the Bokmakierie (*Telephorus zeylonus*) and the Provincial flower, the Yellow Arum Lily (*Zantedeschia pentlandii*).

We are indebted to Mr. Dick Wolff for the beautiful coloured photo of a Bokmakierie at its nest.

3. The geological map of the Barberspan region opposite page 30 of *Fauna and Flora* Bulletin No. 14, 1963, shows the nature reserve's boundary in a thick black line. It should be noted, however, that this is that portion of the Barberspan Nature Reserve, namely about 475 morgen, that is the Province's land. The Barberspan Nature Reserve includes both Barberspan and Leeuwpan and an area one mile wide around Barberspan; its total area is approximately 4,233 morgen.

We are grateful to friends who have helped us with photographs.

Ecological Aspects of Big Game Predation

S. M. Hirst

IN THE field of game conservation probably no subjects have been more heatedly debated than those pertaining to predators and predator control. In the past the basis for such discussion and subsequent action has been largely emotional, and the scientific aspects of predation and the biological role of predators have been overlooked.

Since the beginning of human evolution the carnivorous animals have been regarded in an unfavourable light. In prehistoric times man himself was an important prey species. During the advent of civilization virtually no predator, with the exception of those domesticated for man's own purposes, was compatible with the human way of life. Predators have always appeared to act contrary to man's interests, especially in the agricultural and economic fields. The result is that today predatory animals are generally regarded as being dispensable and as serving no useful purpose.

However, two factors have tended to change this view-point. The first is the establishment, during comparatively recent times, of national parks, nature reserves, refuges and other areas where man has no interests other than aesthetic, educational or scientific ones. The second factor is the research and fact-finding observations which have been carried out in such natural areas, and which have indicated that predation is not as biologically dispensable as was formerly believed.

The question as to what role predators play in the ecology of nature reserves and what degree of management or control is necessary normally resolves itself into a few main topics, viz. what effects do predators have on prey populations; what effects do the prey populations have on the predators; do the predators remove only surplus game or do they actually harm the prey communities; and do the predators remove constitutionally weak and sick animals, or are they impartial as to their feeding habits?

Research into the predator-prey relationships of big game communities has been undertaken mainly in the last two decades. Because of zoogeographical considerations, extent of civilized advancement, land areas and other factors, big game predators are of importance mainly on the African and North American continents, although large predators still occur in the remoter regions of Europe and Asia. In the United States and Canada predators and their biological relationships have been studied fairly intensively, and many of the more valuable principles of predator management have been derived from these studies. In Africa comparatively little work has been done on the large predators despite their prominence and despite the fact that control, to greater or lesser degree, is practised the length and breadth of the continent.

PREDATION AS A LIMITING FACTOR OF GAME POPULATIONS

In considering what effects predators may have on game populations, it is important to realize that predation is but one of several limiting factors which continually operate on all wildlife populations. Parson (1964) has grouped these factors into two main groups—species factors and environmental factors. Species factors consist of the habits of animal species as well as their capacity to reproduce. Environmental factors can be again divided into biotic agencies, physical agencies and factors of the habitat. Biotic agencies include predators, diseases and parasites. Physical agencies are weather and climatic conditions and man's activities such as hunting, agriculture and industry. Factors of the habitat, by far the most important limiting factors of an animal population, are centred on the shelter and food provided by the environment in which the animals have to live.

Limiting factors should be assessed in terms of how much they actually control the population, not how obvious they may be to the observer. A large predator such as a lion or a leopard may make a considerable impression on a human observer when it kills and devours an antelope, and it may seem to the observer that such killing is harmful to the antelope population; yet a limiting factor such as deterioration of the habitat can lead to far greater damage to the same antelope population by lowering the reproductive rate and rendering them more susceptible to disease, predation and adverse climatic factors.

In the United States Craighead and Craighead (1950, 1956) have made an intensive study of predator-prey relationships between raptors and small game animals. Their studies permitted them to postulate several important principles which are directly applicable to big game predation, viz:

"1. Predation is an inexpensive biological control. In the management of wildlife populations we must write off the relatively small portion of the game harvest lost to predation and think of this as a very low cost for the balancing of populations.

"2. Management practices aimed at reducing prey risk factors, which in turn alter the relation between prey density and predation pressure, can within limits increase the population of a desirable prey species. Environmental changes, resulting in increased food and cover, will tend to raise the threshold of security to predation for a given species, and such improvements are likewise beneficial to other species, thus permitting denser populations to exist. The results of such improvements are increased prey densities and somewhat increased predation pressure, but without proportional losses due to the reduction of the prey risk factors. In other words, both the carrying capacity and the threshold of security have been raised.

"3. The threshold of security from predation for a collective prey population over an extensive land area tends to be reached for all prey species at about the same time. Although observations on a single predator species will frequently show concerted pressure on one or a few prey species, this should not blind us to the fact that we are seeing only a fraction of the total picture. The mechanics of predation are such that under natural conditions no single prey species in a total collective prey population can draw sufficient predation pressure to keep its population level dangerously depressed. This we should naturally expect, and this fact cannot be fairly used as an argument against the effectiveness of predation as a controlling factor. The argument that other regulatory forces would become operative in the absence of predation, or that inter-compensation would offset the forces tending to lower populations, has no bearing on the role of predation as a force regulating and at times limiting population levels. The same could be argued for all other potential limiting factors. We must think of inter-compensation as a factor contributing to the breeding potential and predation as one of the environmental resistance factors tending to reduce productivity.

"4. A relatively large percentage of a staple prey population can be killed locally by a population of a single predator species. When this staple prey happens to be economically or otherwise valuable to man, and because of this value it has been too heavily cropped as a population, or has had its environment so altered that it is subject to heavy environmental resistance forces, then predation is very likely to become the limiting factor on its population increase. A staple prey is usually a prolific species, thus it can still be sufficiently abundant to bear the brunt of predation, and yet exhibit a depressed population level. In such instances, temporary control is advisable in order for man to reap a maximum harvest, but it must be remembered that the fundamental disturbance lies not with predation but with other forces and factors. Predator control then should be a finely calculated emergency operation employed only until more basic remedies can be applied.

"5. No single regulatory force such as predation, intra-specific self-limiting mechanisms, disease or emigration will at all times have a controlling effect on prey populations. Although predation can be the limiting factor, we would perhaps have a better concept of predation if we think of it not in terms of when and how it may limit population levels, but rather as a force continually operating to lower prey increase and to do this before more drastic but less steadily functioning forces become dominant.

"6. The checks and balances between predators and prey and other regulatory forces of the environment are the result of an infinite number of causes and effects that have evolved as animal life evolved. The system operates non-objectively, and, in the state of man's present knowledge, is far superior to an objective control by man himself that at best considers only a few causes and effects and always is based on selfish interests. Because man's control has a definite objective in mind, it is no real substitute for nature's impartial method. Economically a certain degree of local predator control will probably always be necessary, especially in the case of predation on decimated, domestic or maladjusted populations, but biologically there is

1. Africa's big game predators are among the world's finest mammals.

Photo: A. Pexton.

seldom need for control and certainly little justification for any type of wildlife management that attempts to reduce any predator population by means of concerted exterminating campaigns. Predation by raptors and carnivores can only be eliminated when man is ready and willing to take over the herculean task of population control of countless animal species."

Errington (1953) pointed out the relationships between predation and other limiting factors. He considered that predation is a perfectly normal part of nature's system and that it depends largely on availability of prey. Animals have territorial and other needs which tend to keep them spaced out. Emergencies and habitat deterioration also limit the number on an area. *The important point is that excess individuals must perish in some way.* Once a prey population has been reduced to suitably low levels, it can live with remarkable security in the presence of many formidable predators. If losses to one predator are heavy, then losses to others tend to diminish proportionately. Many other compensatory factors are at work, and although compensation is not always complete, it is far more important than often thought.

The same author (1956) noted that in all cases two main types of predation must be distinguished, viz. predation which was centred on doomed surpluses or wastage parts of the population, and predation which cut right into a prey population and maintained it at a significantly low level. Although under special conditions a predator may wipe out a prey population, accrued evidence indicates that such predation is in fact incidental and not a significant population depressant. Errington (1963) and Grange (1949) further pointed out that few mammals are adapted to exploit only one particular kind of prey.

In the United States Latham (1952) made a thorough survey of the role of predation in population control. He noted that carnivores do not ordinarily exterminate the species on which they prey. If their prey becomes scarce, they, too, cease to flourish, since they cannot exist in numbers disproportionate to their food. At a given low point, all predator pressure will turn to other foods, whereupon the prey will start to increase again. Gabrielson (1959) pointed out that under special circumstances, either favourable to the predator or unfavourable to the prey, predators may become a real factor in decreasing populations or in preventing recovery following a decline in population.

Latham (op. cit.) concluded that although many mortality factors operate on a prey population, only those which are density dependent can properly control the population, i.e. predation, availability of food, disease and emigration. Weather and climatic factors such as drought are independent of density and so do not control the population although they may decimate it. Gabrielson (op. cit.) went a step further and stated that the agency of predation in reducing large populations is minor compared with the more vital ones of available food, suitable cover, correct interspersion of animals and environmental factors, disease, etc. Any one of these may be more effective than predation in holding back population increases.

Latham (op. cit.), Grange (1949) and Allen (1954) all pointed out that increased predation was invariably caused by some adverse environmental factor. Normally one or more defects in the habitat may be the adverse factor involved. An abnormal rise in predation can usually be correlated with a deterioration of the habitat.

Two important aspects of predator-prey relationships become obvious from the findings of the various workers—firstly, that prey animals which show mass increases have probably escaped the controlling influence of factors such as predation and have reached a new but more dangerous level set by the available food supply: secondly, that if predation becomes the chief limiting factor of a game species, then that species has outlived its environment.

An interesting hypothesis was offered by Nicholson (1947). He suggested that if predators take chiefly weak adults from a given game population, then the number of predators will be limited by the food supply of the prey since the numbers of the prey will be checked only when they reach the food limit. If on the other hand predators take healthy adults, then the means by which the prey can escape become the critical factor. This involves consideration of space and cover rather than food supply. The numbers of the prey will then be held below the food limit.

Dice (1952) referred to the numerous control campaigns against predators. He considered that most if not all attempts to increase the numbers of a desirable species would be ineffective, and that the only real means of obtaining this goal would be to improve the habitat so that the desirable species would be made less vulnerable.

Several workers are of the opinion that in the normal course of events predators only remove population surpluses (Longhurst *et al.* 1952; Errington, 1953, 1956; Gabrielson, 1959), Presnall (1950) considered that this would be the case only in strictly wilderness areas. Latham (1952) considers this view illogical, and suggests that food supply, cover and intolerance to crowding will permit larger numbers of game animals if predators are removed. He points out that predation simply magnifies the depressive action of the other controlling factors.

FIELD STUDIES OF PREDATION AS A BIG GAME LIMITING FACTOR

Much useful information on the relationships between big game and their respective predators has been obtained by researchers in North America. Despite tremendous advancement during the present century, America and Canada still retain large areas in the form of national parks, refuges, forests and other recreational areas where predators are of importance.

There are a number of species that can be classed as big game predators in North America. These include the Cougar or Puma (*Felis concolor*), Jaguar (*Felis onca*), Wolf (*Canis lupus*) and Coyote (*Canis latrans*). Certain other species including the Black Bear (*Euarctos americanus*), the Grizzly Bear (*Ursus sp.*), the Lynx (*Lynx canadensis*) and the Bobcat (*Lynx rufus*) occasionally prey on large game animals, but are not of great ecological significance in this regard.

In the Glacier National Park Aiton (1938) made a study of the causes of mortality in Whitetail Deer (*Odocoileus virginianus*) and found that 25% of those lost were killed by coyotes; cougars took a further 0.8%, wolves 0.4% and feral dogs 0.4%; 64.6% of the mortalities were due to undisclosed causes.

Numerous workers in the United States have referred to irruptions of deer and Pronghorn Antelope populations following the removal of the larger predators. Leopold *et al.* (1947) pointed out that similar irruptions were unknown in Mexico and very rare in Canada, and that both these countries retained cougars and wolves. Leopold also noted that overbrowsing of forests in Europe by deer had only occurred when the predators had been removed.

A striking example of the repercussions of unwarranted predator control is afforded by the deer problem on the Kaibab Plateau in the Grand Canyon National Park. (Boone, 1938; Allen, 1954.) In an attempt to preserve a herd of mule deer (*Odocoileus hemionus*), all deer hunting was prohibited in 1906. During the following twenty-five years a total of 781 cougars, 30 wolves

4,889 coyotes and 554 bobcats was shot. The deer herd, which numbered 4,000 in 1906, increased to 100,000 in 1924. The result was that 80-90% of the available forage was destroyed and large-scale mortality ensued. The herd numbered 20,000 in 1930 and by 1940 this had again dropped to 10,000 Allen (op. cit.) also points out that indiscriminate removal of cougars and wolves from the Yellowstone National Park has resulted in severe damage to the habitat by large deer populations. Similar findings were reported by Leopold *et al.* (1951) in the Jawbone region of California; the main cause of deer mortality was found to be starvation; predators played a very minor role.

Situations similar to that on the Kaibab Plateau have been reported for other game species. Udy (1954) noted that the Pronghorn Antelope (*Antilocapra americana*) numbered only 670 in Utah in 1922. Little change was evident until 1948, when coyote control was initiated. This led to a marked increase in fawn survival, but the range could not support the larger antelope population, and winter losses amounted to some 60%. Increase in fawn survival after coyote control was also reported to have occurred in northern Arizona (Arrington and Edwards, 1951). Gabrielson (1954) described a marked increase in Pronghorn Antelope numbers in Nevada, Oregon and California after control of coyotes and bobcats, but pointed out that the herds were then subject to more destructive limiting factors.

In contrast to the above findings, researchers have found that in most cases wolf predation on game herds is not of great significance. Murie (1957) considered that in the United States space and food supplies were of far greater significance than wolf predation. Wolves could not be held responsible for the extermination of certain game herds as they tended to concentrate mainly on sick and injured game. In Canada Banfield (1954) estimated that wolves took not more than 5% of caribou herds, and of this the majority was aged and very young animals. Kelsall (1959) reported similar findings and estimated that on the average wolves took only 14 caribou a year each.

In Africa, despite the abundance and variety of predators, research has been limited and has been mainly undertaken during the past decade. Earlier notes and reports are confined mainly to those of Stevenson-Hamilton (1937). Despite the fact that a policy of predator control was carried out in the Kruger National Park, Stevenson-Hamilton considered that had the predators been left strictly alone, no serious damage would have occurred to the game populations. He cited the example of wild dogs (*Lycaon pictus*) which were numerous in the Kruger Park prior to the predator control operations; despite this, Impala (*Aepyceros melampus*) managed to hold their own. The Shingwedzi portion of the Park carried virtually no game in 1903. Exclusion of hunters and poachers led to a gradual improvement in game numbers despite the fact that Lions (*Panthera leo*) increased in number as well.

Bigalke (1955), in considering the status of the Sable Antelope (*Hippotragus niger*) in the southern regions of the Kruger National Park, pointed out that the status in 1955 was the same as that in 1893, despite the radical changes in predator populations. He considered that the relative scarcity of these antelopes in these areas was not due to lion predation, but to the fact that the animals were at the southern limits of their distribution, and that therefore they would never be numerous.

Wright (1960) has made a detailed study of big game predation in East Africa. He found that in general predators killed more males than females, the ratio being approximately 60:40. Of the kills examined, 65% were found to be either in their prime or old. 93% of the animals killed were healthy.

He cites the specific instance where Leopard (*Panthera pardus*) control had led to such severe baboon (*Papio sp.*) depredation that leopards had to be translocated from other areas to deal with the menace.

In the Wankie National Park in Rhodesia, Dasmann and Mossman (1962) estimated a ratio of one lion for every 110 ungulates; they further estimated that lions removed approximately one-third of the ungulate population each year. They also found that in the Fort Tuli area a high population of lions did not control the increases in ungulate numbers, and that starvation was common during the dry season. They drew a correlation between a high percentage of young animals in a herd with a heavy predation pressure on the herd.

The effects of predation on the White-bearded Wildebeest (*Connochaetes taurinus albojubatus*) in Western Masailand in East Africa have been extensively studied by Talbot and Talbot (1963). They found that predation accounted for some 13,500 to 20,000 wildebeest annually; this represented between 4.7 and 7.0% of the total wildebeest population. In their investigations into the causes of mortality of wildebeest of all ages, they found that 36.5% of those lost were taken by predators, 47.3% were killed by disease and 14.2% were lost through accidents. In the case of adult animals alone 75% of the losses was due to lion predation, 7% to other predators and 18% to accidents and poaching. Of the calf losses 60% was post-natal loss—taken by Spotted Hyaenas (*Crocuta crocuta*) or separated from their mothers, 30% was due to rinderpest and 10% due to accidents and other forms of predation. The Talbots concluded that predation on adult animals exerted little limiting influence on the population. They found that most losses were density dependent, and this was the largest limiting factor. The herd size was considered to be a function of the topography, the vegetation and the rainfall.

Much stress has been laid on the possible limiting effects predators may have on their prey, but it must be borne in mind that the prey animals represent no less a controlling influence on predator numbers. Predators which have a wide spectrum of species upon which they can prey are less influenced by changes in any one prey population than those which are confined to fewer prey species. Thus in the case of cougars in California, it was found that their numbers correlated closely with deer numbers although there was a two-year lag between the fluctuations.

Predatory animals are frequently more prolific than ungulates, and this represents a valuable means of adjusting their numbers to suit environmental conditions. A striking example is that of lion populations in the Kruger National Park (Stevenson-Hamilton, 1937). When lion control was initiated in the area, it was discovered that the population tended to remain static, as the decrease in competition for available game enabled lionesses to rear four to five cubs instead of two or three as was the case previously. When lion control ceased, reproduction decreased due to a higher incidence of cub starvation and mortality.

REMOVAL OF DISEASED AND CONSTITUTIONALLY WEAK GAME BY PREDATORS

Practically all workers who have investigated the various aspects of predation are agreed that in natural areas the predator plays a valuable role in eliminating weak and sick animals. Wing (1951) points out that preference for less vigorous animals indicates normal conditions.

Several workers (cited by Latham, 1952) have pointed out the essential differences between natural predation and removal of game by man. In the latter case it is usually the fittest and largest and therefore genetically the best animals which are lost to the populations.

In North America Murie (1944) found that wolf predation had a beneficial effect on Dall Sheep (*Ovis dalli*) over a long period of time by removing old, crippled, weak and diseased animals. Allen (1954) refers to cases in Wyoming where coyotes effectively removed Bighorn (*Ovis canadensis*) lambs suffering from epizoötic pneumonia. Wolves are especially credited with removing sick Caribou (*Rangifer tarandus*) (Crisler, 1956; Murie, 1957). In the case of Bison (*Bison bison*) Fuller (1962) found that wolves removed three classes of animals—young, old and handicapped.

Similar findings are reported from Europe. In Sweden Borg (1962) noted that predators accounted for 15% of all Roe Deer (*Capreolus capreolus*) lost, and of these 54.5% were found to be diseased.

In Africa predators are credited with preventing the spread of diseases in the Kruger National Park (Ann. Rep. Biologist 1958/59). In East Africa this view is also supported (Talbot and Talbot, 1963).

2. There is no place for the weak and unwary in wildlife communities.
Photo: Dick Reucassel, A.R.P.S.

PREDATOR MANAGEMENT IN THE UNITED STATES

Big game predators in the United States are today largely confined to national parks, forests and lands immediately adjoining such areas. Outside of these regions they invariably come into conflict with agriculture and are rapidly eliminated.

As in many other cases, management of predators in American national parks was initially based on personal beliefs, prejudices and haphazard observation. As a result, the official policy towards carnivorous animals was simply one of extermination. The change of view over a period of more than fifty years is well illustrated in the case of Yellowstone National Park (Cahalane, 1939).

Yellowstone was founded in 1872, and between that date and 1887 all predators were hunted. In 1887 the tourist value of these animals was recognized and hunting temporarily ceased. It was resumed on an intensive scale in 1896. With the changes in administration, the policy was gradually modified from one of extermination to one of control. The management policy was only placed on a firm footing in 1931.

In 1939 the U.S. Park Service issued a policy statement (Ise, 1961): "No native predator shall be destroyed on account of its normal utilization of any other park animal, excepting if that animal is in immediate danger of extermination, and then only if the predator is not itself a vanishing form; when control is necessary it shall be accomplished by transplanting or, if necessary, by killing offending individuals, not by campaigns to reduce the general population of a species".

This policy of protection of predators as a valuable facet of the ecosystem has been amplified by the findings of the Advisory Board on Wildlife Management (Leopold *et al.* 1963), who advised that control of animal populations in the national parks through natural predation should be encouraged, and not only should the larger predators be protected in the parks but great efforts should be made to intensify their protection in the surrounding areas. The same Board later (Leopold *et al.* 1964) drew attention to the fact that predator control is not necessarily an effective form of management, and that predator control for the protection of other forms of wildlife should only be undertaken after competent research had shown it to be desirable and locally needed.

PREDATOR MANAGEMENT IN AFRICA

As in the case of the United States, predator management in African big game areas has for many years been of a haphazard nature, and it is only within the last decade that realistic attitudes towards predators have been developed.

The development of such an attitude towards predators is typified by the changes in predator control policies in the Kruger National Park.

In 1902 game populations were low in the area due to rinderpest and severe hunting and poaching. A predator control programme was commenced in order to build up the game herds. This policy was pursued in haphazard fashion during the ensuing five decades, and in 1955 it was stated that control would only be exercised in order to safeguard species such as Tsessebe (*Damaliscus lunatus*), Sable (*Hippotragus niger*), Roan (*H. equinus*) and Eland (*Taurotragus oryx*). Control would be limited to certain areas only. By 1961 it was realized that in a fenced reserve predator control would have to be kept at a minimum. Problems created by over-populations of prey animals were more damaging and more irreparable than those caused by predominance of predators. The following year it was stated that predators in the Kruger National Park appeared to have no noteworthy influence on the growth rate of the prey community.

Pienaar (1963) pointed out that today the prey populations in the Kruger National Park have reached an advanced level despite a high population of lions. In view of this, the predator control measures of the past had to be regarded with considerable misgiving. Pienaar also considers that the control measures applied to certain species, notably Cheetah (*Acinonyx jubatus*), were completely unjustified.

PREDATOR RESEARCH IN AFRICA

It has become abundantly clear from the facts presented here that any form of predator management or control not based on thorough research may be not only futile, but damaging to game populations and habitats.

A number of important projects on African predators have been undertaken recently and have shed a great deal of light on the role of predators in African big game ecology.

Brooks (1961) in a study of the Thomson's Gazelle (*Gazella thomsoni*) in Tanganyika noted that hyaenas were the chief predators. In order of importance the main predators were hyaena, lion, cheetah, jackal, leopard, wild dogs and raptorial birds. No indication of the extent of each form of predation is given.

Wright (1960) has made an important study of big game predation in East Africa. He noted that the average number of lions per pride in Tanganyika was 6.0. On the Serengeti Plains he estimated an average of only 2.7 immature lions per pride, which indicated that the lion population was at the limit of its food supply. A record of kills over an extended period indicated the following proportions of game animals killed by the main predators.

Lion:	wildebeest	49%
	zebra	15%
	Thomson's gazelle	10%
	buffalo	5%
	giraffe	4%
	impala	3%
	kongoni	2%
	eland	2%
	ostrich, Grant's gazelle, topi, porcupine, tortoise, hippo, bushpig	traces
Leopard:	Thomson's gazelle	47%
	wildebeest	13%
	impala	13%
	zebra	7%
	baboon	7%
	miscellaneous	13%
Wild dog:	Thomson's gazelle	70%
	wildebeest	10%
	reedbuck	10%
	impala	10%
Cheetah:	Thomson's gazelle	58%
	impala	25%
	wildebeest	8%
	Grant's gazelle	8%

From his data Wright estimated the relative vulnerability of the various ungulate species by noting the numbers of actual predators which preyed on them:—

Thomson's gazelle	10	buffalo	1
impala	7	giraffe	1
wildebeest	4	kongoni	1
zebra	3	eland	1
Grant's gazelle	2		

Wright's figures further indicated that leopard and wild dog were the most economical predators; lions, and to a certain extent cheetahs, killed more than they needed—the balanee was removed by scavengers. Records kept of three prides of lions showed that they killed 243, 305 and 281 animals per year respectively.

Lamprey (1963) noted that associations of different species of ungulates were brought about by the presence of predators in the Tarangire Game Reserve in Tanganyika. Thus he noted single male wildebeest running with zebra herds, single oryx associating with zebra and wildebeest, impala and waterbuck together, and impala and zebra remaining close to giraffe.

Talbot and Talbot (1963) have made an extensive study of the White-bearded Wildebeest in East Africa, and their studies included predation. They found that lions were the main predators of adult animals, whereas hyaenas were the most important in the case of very young and very old animals. One lion was estimated to account for 35 prey animals per year; an average pride of three lions killed an average of two ungulates per week, On the Serengeti Plains lions annually removed 12,000 to 18,000 wildebeest per year which only amounted to 5-7% of the total population. An analysis of predation data relating to the wildebeest showed that lions were responsible for 91.1%, cheetahs 3.3%, leopards 2.2%, hyaenas 2.2% and wild dogs 1.1%.

In Central Africa Mitchell *et al.* (in press) analysed kill data obtained in the Kafue National Park. They noted that leopards had 22 potential prey species, lion 19, wild dog 15 and cheetah only 11. The overall sex ratio of all detected kills was 54.4% males and 45.6% females. Most animals killed were in good condition.

CONCLUSION

Although many aspects of predation remain to be clarified, certain points have become abundantly clear from research carried out in recent years. Briefly these are:—

1. Predation is a limiting factor of game populations, but the extent varies. In well-balanced ecosystems predation appears to limit the population in so far as it prevents population levels being maintained by more dangerous limits such as food supply.
2. Predation is an effective biological control of sick and diseased game and generally maintains a high genetic standard in game herds.
3. Predation cannot be held responsible for reducing game populations to dangerous levels. It may represent an added threat to very small or unstable populations, but in such cases improvements of the habitat will have greater and more concrete benefits than control of the predators.
4. In natural areas predators are a most valuable asset and should be managed in scientific fashion to derive the greatest benefit from their activities. Grange (1949) has summed up the correct approach to predator management by stating that control should
    - (i) be based upon facts which substantiate the need for control;
    - (ii) be selective, i.e., only apply to those predators in need of control;
    - (iii) have as its objective the *control* of the predator and not its *elimination;*
    - (iv) be maintained at the minimum level consistent with the desired results.

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Random Observations on the Food Habits of Certain Carnivora (Mammalia) in Southern Africa

J. du P. Bothma

FROM the existing literature on the ecology of the Southern African Carnivora, it is often noticeable how little is actually known about the food habits of many of these animals. If the relative rarity of some of the species is taken into account, it will be realized how slender the chances are of getting a clear picture of this aspect without launching a full-scale investigation.

The data presented here were collected at random during a more intensive study of the food habits of *Canis mesomelas* (Black-backed Jackal) and *Vulpes chama* (Silver Fox), which is still under way. They are, therefore, random observations and are not representative of the complete diet of the animals concerned. Nevertheless they serve to support our present knowledge and in some cases even add to it.

Varying numbers of stomachs of four mammalian families (six species) of the order Carnivora were examined volumetrically and the following results were obtained:—

PROTELIDAE

Proteles cristatus: Aardwolf.

The Aardwolf, a relative but long-degenerate form of *Hyaena*, is found singly in most of the arid areas of Southern Africa. It is a peculiar animal confined to Africa, where it ranges from the Cape to the Mediterranean (Roberts, 1951). It is nocturnal and fossorial in habits (Shortridge, 1934) and although aften abundant in certain areas, it is apt to be overlooked by a casual observer.

The role played by *Proteles cristatus* as a predator on domestic stock has long led to speculation and argument. This is evident from Sclater (1900):— " . . . it is constantly reported by farmers that young sheep and kids are carried off by the aard wolf." Whether this is true will always remain debatable until a detailed study of the matter has been made. However, in the aardwolf stomachs which I examined, no evidence of domestic stock was found. The canine teeth of *Proteles cristatus* are not adapted for killing stock.

As far as its natural food is concerned, ants and termites are considered to be the main food items (Sparrman and Cloete: *In* Sclater, 1900). Shortridge (1934) adds locusts, beetles, and less frequently small rodents, reptiles, the nestlings and eggs of ground-nesting birds and an occasional ostrich egg to this list. According to Shortridge (1934) the aardwolf does not eat carrion, but as far as personal observation is concerned, this is incorrect as carrion was found to constitute a large portion of the stomach contents of at least one animal in the present work (see below).

1. A young Aardwolf. Photo: H. Lang.

Six stomachs of *Proteles cristatus* were examined. In general they contained food items similar to those mentioned above. This is evident from the following:—

Total food volume	1024.0 cc.
Average	170.7 cc.
Range	0-410 cc.

One stomach was empty.

The bulk of the stomach contents consisted of the long-nosed harvester termites *Trinervitermes haberlandi*. Four of the six stomachs, those from Bloemhof, Delmas and Wolmaransstad (Transvaal) and New Hanover (Natal), contained only these termites. One other stomach was empty (Delareyville, Transvaal) while a stomach from Warmbaths (Transvaal) contained the following.:—

TABLE 1

Stomach contents of a female adult Proteles cristatus *from the farm Sandfontein, Warmbaths (Transvaal), collected in February, 1962.*

Item	*Total volume*	*Percentage of total volume*
Total food volume	410.0 cc.	100.0
Carrion	328.3 cc.	80.1
1 Rodent (rat) unidentified	27.5 cc.	6.7
Green grass	27.0 cc.	6.6
16 Insects	15.6 cc.	3.8
1 Tortoise (mostly scales)	11.6 cc.	2.8

The insects included 5 large dung-beetles (Coleoptera); 8 flying ants (Hymenoptera) and 3 unidentified larvae. The tortoise, possibly a *Geochelone pardalis*, was a juvenile. No indication of domestic stock was found in this or in any of the other stomachs.

VIVERRIDAE

Viverra civetta: African Civet.

The African Civet is one of the largest species of the Viverridae (Roberts, 1951). In Southern Africa its known range includes the coastal parts of northern Zululand, Moçambique, Transvaal, Southern Rhodesia, Ngamiland, the Caprivi Strip and northern South West Africa (Meester, Davis and Coetzee, 1964).

Civets are terrestrial and nocturnal (Roberts, 1951); they wander around mainly at night in search of food. This includes a large variety of small animals, such as terrestrial birds, small mammals, lower vertebrates and invertebrates and even vegetable matter (Roberts, op. cit.).

The stomachs of two civets, both from the vicinity of Pretorius Kop in the Kruger National Park, Transvaal, revealed the following:—

Total food volume	331 cc.
Average	165.5 cc.
Range	97-234 cc.

The stomach contents included the following:—

TABLE 2

Stomach contents of a male and a female adult Viverra civetta *from the Pretorius Kop vicinity in the Kruger National Park (Transvaal) collected in August 1962.*

Item	*Total volume*	*Percentage of total volume*
Mammals	26.0 cc.	7.9
Tragelaphus strepsiceros (Kudu)	25.0 cc.	7.5
Thryonomys swinderianus (Cane Rat)	1.0 cc.	0.3
Birds	67.1 cc.	20.3
Numida meleagris (Guinea-fowl)	67.0 cc.	20.2
Egg-shell (of guinea-fowl?)	0.1 cc.	0.1
Carrion	201.1 cc.	60.7
Insects	30.8 cc.	9.3
Macrotermes swaziae (Termite)	0.3 cc.	0.1
Hodotermes mossambicus (Termite)	30.0 cc.	9.0
Peropsophus sp. (Beetle	0.5 cc.	0.2
Vegetation (Grass and leaves)	3.6 cc.	1.1
Grit and sand	2.5 cc.	0.8

The Kudu was present as scraps of meat with the hair attached. It probably represents the remnants of the prey of a larger predator. However, it is also possible that the civet had attacked and killed a very young kudu. It is, therefore, uncertain whether the kudu meat in this case represents carrion or prey. The nature of the meat was identified by a microscopical analysis of the hair. Of the cane rat, only the remains of an incisor and a molar were found. Evidently it had been consumed a considerable time before the predator was killed.

2. An African Civet. Photo: H. Lang.

The guinea-fowl and egg-shell remains seem to suggest that this bird was killed on its nest. As its remains consisted mostly of feathers, it is difficult to determine precisely what percentage of the total food volume it actually forms.

Carrion, present as 85.9% of the food in one stomach, and as 60.7% of the total food volume, was the major food item by volume in the stomachs.

The invertebrates consisted of three species of insects. By volume the major item in this case proved to be the termite *Hodotermes mossambicus;* 1,033 heads of this insect species were counted in a single stomach. Finally, mixed vegetation (grass and leaves mostly) and sand and grit were present to a lesser degree.

CANIDAE

Canis adustus: Side-striped Jackal.

This is the largest, and one of the lesser known species of jackal in Southern Africa. According to Meester *et al.* (1964) it is confined to tropical and subtropical areas, which in Southern Africa include the following:—Northern Zululand, Moçambique, eastern and northern Transvaal, Southern Rhodesia Caprivi Strip, Ngamiland and northern South West Africa. However, the stomachs examined in this study were collected from Zeekoegat, Trichardt, in the Bethal district of Transvaal, which is neither subtropical nor tropical.

According to Sclater (1900) they hunt in packs and prey on small mammals and sick individuals of larger species. The Side-striped Jackal is mainly nocturnal and also eats carrion, ground-roosting birds, lizards, insects and wild fruit (Shortridge, 1934).

Three stomachs were examined and the following found:—

Total food volume	313 cc.
Average	104.3 cc.
Range	33-170 cc.

The contents of one stomach (adult male) consisted entirely of fresh oribi meat and hair (*Ourebia ourebi*), while an adult female had apparently eaten green grass only (33 cc.) prior to being killed. The stomach contents of the third individual, a young male approximately five months old, consisted almost entirely of domestic sheep. In addition it contained the remains of one grasshopper and a trace of green grass.

Otocyon megalotis: Delalande's or Bat-eared Fox.

Range in Southern Africa: Northern and north-western Cape Province, Orange Free State, perhaps western Transvaal, western Southern Rhodesia, Bechuanaland and South West Africa, except possibly the Namib Desert (Meester *et al.*, 1964).

Although essentially nocturnal, it is not unusual to see an odd pair wandering about by day in regions where they are fairly plentiful (Shortridge, 1934). Its food is said to consist of mice, birds, insects, termites, fruit (Sclater, 1900), lizards and carrion (Shortridge, 1934).

One stomach only, from Rusdam, Thaba 'Nchu, in the Orange Free State, was available for study. It contained a total food volume of 153 cc. which consisted of the following.

TABLE 3

Stomach contents of an Otocyon megalotis, *age and sex unknown, collected in the Thaba 'Nchu district (Orange Free State) in May, 1962.*

Item	*Total volume*	*Percentage of total volume*
1 Rodent (mouse) unidentified	30.0 cc.	19.6
1 Lizard unidentified	18.0 cc.	11.8
Carrion	105.0 cc.	68.6

Hence nothing new was found in the diet of this fox.

FELIDAE

Felis caracal: Lynx or Caracal.

Especially abundant in certain parts of the Cape Province where, due to its attacks on domestic stock, it has been added to the list of vermin. It also occurs in the following parts of Southern Africa: Orange Free State, eastern Transvaal, Mocambique, Southern Rhodesia, Bechuanaland, Caprivi Strip and South West Africa (Meester *et al.*, 1964).

The Caracal is partial to hilly country where it finds refuge in masses of tumbled boulders (Roberts, 1951). It apparently hunts by day in cool or cloudy weather (Shortridge, 1934). Its food includes the following:—Domestic stock; small antelopes and the Cape Grey Mongoose *Herpestes pulverulentus* (Sclater, 1900), hares, monkeys, dassies, guinea-fowl, ostriches and even a large cobra (Shortridge, 1934). It frequently drags the remains of its kills into the fork of a tree or hides them amongst bushes or rocks where trees are absent (Roberts, 1951).

The stomach contents of a male adult Caracal from Steenboksvlakte near Robertson in the Cape Province were examined. It contained the following:—

TABLE 4

Stomach contents of a male adult Felis caracal *from Steenboksvlakte, Robertson, in the Cape Province, collected in October, 1963.*

Item	*Total volume*	*Percentage of total volume*
Total food volume	370.0 cc.	100.0

1 Young and 5 adult striped mice (*Rhabdomys pumilio*)	148.0 cc.	40.0
1 Grey Duiker (*Sylvicapra grimmia*)	30.0 cc.	8.1
Grapes	192.0 cc.	51.9
A trace of green grass	—	—

It is surprising that the Caracal also eats plant food and especially surprising that it consisted of a cultivated crop in this case.

Felis nigripes: Black-footed Cat.

A small species of the Felidae distributed in Southern Africa over the eastern and northern Cape Province, the Orange Free State, western Transvaal, Bechuanaland and South West Africa (Meester *et al.*). It is said to hide by day in the holes of the Springhare and other burrowing animals (Shortridge, 1934).

Little is actually known about the nature of its natural food, although its diet is doubtless the same as that of the other wild cats, i.e. small rodents, birds and lower vertebrates (Roberts, 1951).

3. A Black-footed Cat. Photo: H. Lang.

The contents of the stomach of an adult male Black-footed Cat from the S.A. Lombard Nature Reserve near Bloemhof revealed the following:—

TABLE 5

Stomach contents of a Felis nigripes *adult male collected in the S.A. Lombard Nature Reserve near Bloemhof (Transvaal) in August, 1964.*

Item	*Total volume*	*Percentage of total volume*
Total food volume	325.0 cc.	100.0
Mammals	321.0 cc.	98.8
Xerus inauris (Ground-squirrel)	155.0 cc.	47.7
Tatera sp. (Gerbil)	50.0 cc.	15.4
Birds (feathers only)	3.0 cc.	0.9
Green grass	1.0 cc.	0.3
Sand and grit (Trace)	—	—

It is interesting to note that this black-footed cat succeeded in killing a prey the size of a ground-squirrel.

The fresh weight of the stomach was 261.1 gm.

CONCLUSIONS

Although the above data are incomplete, they do give some indication of what these carnivores eat. It is also evident that many of these species are in fact more omnivorous than carnivorous, since plant food is eaten as frequently as animal food but to a lesser degree. But the latter remains the major food source for these Carnivora.

ACKNOWLEDGEMENTS

The following assisted in the identification of various food items and their help is gratefully acknowledged:—Mr. C. Coetzee of the Transvaal Museum, who identified the mammals, and Mr. W. Haacke of the same museum who identified the invertebrates, while Mr. I. Prinsloo of the S.A. Lombard Nature Reserve undertook the identification of some mammalian hair microscopically.

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Interesting Facts about the Crowned Guinea-fowl

(Numida meleagris)

T. Farkas.

THE Crowned Guinea-fowl (*Numida meleagris*) is distributed throughout the African continent in the form of numerous sub-species, and is highly prized everywhere as a game bird. Due to its savoury flesh, this bird was regarded as a great delicacy by the ancient Greeks and Romans, but at that time gourmets were obliged to pay fairly high prices for these birds, as they had to be imported alive from either Nubia or North-West Africa. After the fall of the Roman Empire these birds were presumed to have disappeared from Europe, there being no evidence to the contrary. Only in recent times did they reappear there, having been imported, as the name "guinea-fowl" suggests, from the west coast of Africa, where the local race of *Numida meleagris* had already been partially domesticated by the natives for some considerable time. Thus the domesticated form of the guinea-fowl with which we are now familiar, and which is widely distributed throughout Southern and Central Europe, although nowhere in large numbers, is directly descended from this West-African sub-species.

Apart from its eligibility as a table bird, this domesticated form is notable for its egg-laying capacity. Capable of producing up to one hundred eggs per year, it may, as compared with its wild relatives, be regarded as an active egg-producer. Besides being particularly tasty, the eggs have an unusually thick shell as a result of which they keep fresh longer than fowl eggs. As already mentioned, this domesticated form is not kept in large numbers in Southern Europe, although its distribution there is fairly wide. The reason why this bird with its desirable characteristics is not kept and reared in greater numbers lies mainly in the biology of its reproductive cycle, and in the ecological requirements of the species, both in the wild and the domesticated form. The guinea-fowl is a monogamous bird which, at least during the breeding season, occurs in pairs. After the chickens have hatched, both parents assist in their rearing. The birds are, moreover, thermophilic and hence unable to endure protracted periods of rain and cold.

A further difficulty, and one which tends to restrict their distribution, is the fact that the European farmers know little about the breeding habits of the species. Eggs are laid indiscriminately about the garden and yard, and those which are found are usually placed under a fowl or in an incubator. Another factor which detracts from the popularity of the guinea-fowl as a domestic bird is the state of semi-tameness by which it is usually characterized. On the slightest provocation the birds fly off into the veld, returning only in the evening; they may even decide to establish themselves on a neighbour's property. Thus the combined effect of all these undesirable characteristics has militated against the abundance of the domesticated form in Europe.

Another attempt to introduce this bird as a game bird met with far greater success in the Antilles in the Caribbean Sea, where it is now widely distributed in the wild state and is regarded as a popular game bird.

Crowned Guinea-fowls. Photo: Dick Wolff.

The fact that the guinea-fowl is so well known renders a detailed description of the bird unnecessary. It should, however, be stated that five subspecies occur in South Africa, which are distinguished according to the size and shape of the casque, the markings on the neck feathers and the presence or absence of papillae on the cere. With regard to plumage, mention should be made of the fact that the domesticated guinea-fowl very often manifests a tendency towards partial or complete albinism; this is by no means unusual, since this phenomenon commonly asserts itself in other semi-domesticated birds just as in the case of wild birds bred in captivity.

The guinea-fowl is predominantly an insect eater and as such is of particular significance to the farmer. The above-mentioned tendency of the domesticated form to desert the farmyard in favour of the open veld is in fact associated with this food requirement. As the farmyard diet consists mainly of ordinary fowl food (mealies, wheat, etc.), the birds are compelled to search independently for the indispensable insect food. Thus the guinea-fowl is very useful both as a domestic bird and on the farm as a whole; this fact applies to an even greater extent to the wild form. Although I had already familiarized myself with the diet of the guinea-fowl through studying various European publications, I was deeply impressed by the comprehensive collection of guinea-fowl stomach contents shown to me by Dr. Lorenz of the Department of Agricultural Technical Services, Pretoria. More than 80% of the contents consisted of insects, *inter alia*, hairy caterpillars and species of beetles rarely eaten by other birds, the rest being made up of weed seeds or soft plant material. Research into the ecology of the guinea-fowl conducted by Mr. Siegfried of the Cape Nature Conservation Department will doubtless reveal further interesting facts when the work is published in the near future.

Mr. Skead of the Percy FitzPatrick Institute in Cape Town examined 44 specimens collected chiefly from June to August. His findings indicate a mixed diet, the animal factor (insects) playing an important role in the composition of the stomach contents. Further north Benson collected and examined specimens during the rainy season and during the dry winter in Zambia. The stomachs of the "drought" specimens contained mainly vegetable matter, while animal matter predominated in the stomachs of those birds collected during the rainy season.

In the Luangwa Valley Angus and Wilson made an intensive study of the diet of the guinea-fowl. In several areas under agriculture persons protested against the "damage" caused by guinea-fowls to young plants and to their seeds in particular. As a result of these protests, the local Department of Agriculture nominated the above-mentioned experts to investigate their validity. The latter proceeded to capture a large number of guinea-fowls in a portion of the Luangwa Valley devoted to the cultivation of maize, sunflowers, cotton, ground-nuts, soya beans, etc. The stomach contents of the birds were analysed, and it was found that various weed seeds and a few mealies and ground-nuts were intermingled with the other vegetable components, mainly in the form of grass and Cyperus-seeds. With regard to the mealies and ground-nuts, the experts declared forthwith that their presence was coincident with post-harvesting periods; in other words, the seeds had been picked up in the fields by the birds after the annual harvest. It very often happens that guinea-fowls peck at mealie cobs, but this usually occurs in the case of cobs which have been attacked by termites.

The investigations of Angus and Wilson further revealed that the stomach contents of birds between January and April, i.e. in the rainy season, consisted mainly of animal matter. The researchers identified forty species of insects as well as snails and millipedes; however, at this time grass, weed and Cyperus-seeds were still well represented in the stomachs. These observations tend to corroborate the aforementioned statements to a considerable extent. Even the European observations mentioned by me, in which an insectivorous diet predominated, without doubt fitted closely into this general pattern of the guinea-fowls' diet.

In view of these findings, it is perfectly logical to infer that the guinea-fowl is one of the farmer's greatest allies. One often hears that after the seed, maize in particular, has been planted, guinea-fowls descend in flocks on the newly-planted fields and "devour or scratch out the seed". This complaint is to a certain extent valid, since the birds do at times overrun such fields; but the belief that they do so for the purpose of eating the grain is fallacious. It is often the presence of large numbers of insects which is responsible for attracting the birds; hence the more guinea-fowls present in the fields after planting, the more grateful should the farmer be, since the number of birds is a true reflection of the number of potentially destructive insect pests present. It can, and does, often happen that the birds pick up an occasional maize kernel, but when the losses thus incurred are compared with the incalculable numbers of insects eaten, they become negligible indeed. Several of my farmer friends in West Transvaal, who investigated the accuracy of my contention on their own initiative, later imparted the gratifying information that in the stomachs of guinea-fowls collected on newly-planted fields practically only "goggas" were found.

Finally, when studying the question of nourishment, it should be remembered that these birds often cover greater distances particularly in the winter in their search for food—a fact which tends to enhance their usefulness.

During November and December, i.e. at the commencement of the rainy season, the large flocks of guinea-fowls disperse and pair off, as they are monogamous; each pair occupies a fairly large territory. Under a small bush or in dense high grass the hen scrapes a hollow, which she then fashions into a nest by lining it with dry grass and feathers. In the vicinity of Barberspan, where suitable nesting facilities are apparently not very numerous, I was able to locate an unusually large number of nests within the confines of the research station's grounds about one morgen in extent. Here the birds availed themselves of the nesting facilities offered by many shrubs and made their nests in unusually close proximity to one another. After the eggs hatched, however, the parents led their progeny into the open veld and established their respective territories in uniform fashion. Accordingly the familiar call of the guinea-fowl is heard from all corners of the sanctuary during the breeding season.

A guinea-fowl usually has from 8-12 and on rarer occasions as many as 16 eggs in a clutch. The incubation period (reckoned from the laying of the last egg) is about 24-25 days. The nests suffer heavily from the depredations of cats, dogs and mongooses, and from my own observations I have concluded that more than 50% of the nests are destroyed in this manner. Immediately after hatching the beautiful striped chickens take refuge beneath the hen where they may remain for several hours. It may occur that the hen only leads her brood into the veld early on the morning after the day of hatching.

In order to secure data relating to the weight increase of young guinea-fowls, we removed two clutches of eggs and placed them under a broody domestic hen. The hen successfully incubated the eggs and reared the young. It was interesting to note that despite the differences between the calls of the guinea-fowl chickens and domestic chickens on the one hand, and between the adult guinea-fowl and domestic hen on the other, the guinea-fowl chicks and their foster-mother invariably reacted correctly to each other's calls, even to the warning cry of the domestic hen, which deviates greatly from that of the guinea-fowl.

These guinea-fowl chicks did not touch food on the first day; only on the second did they begin to pick up termites and finely crushed mealies. It was interesting to note that, even when the young had attained a stage of development where they were no longer dependent on the foster-mother, they continued to show a preference for termites or other insects and only took grain when no insects were available. They were kept in a very spacious fowl-run in the garden, where they were able to catch a variety of live insects in the grass. The brood suffered only two casualties, one in the first fortnight and the second during the fourth month. Both losses occurred after cool rainy days, which gives some indication of the role which the weather plays in the successful rearing of this species. During the first three weeks two new-comers attached themselves to the brood; these had probably become separated from their parents and were attracted by the regular soft calls emitted by our own chickens.

The domestic hen reared the chickens up to the age of two months, when we removed the young. As the data acquired in the course of this experiment may be of interest to farmers, I have tabulated the respective weight increases of the chicks as follows:—

Average weight increases of fourteen guinea-fowls chickens.

Week	*Weight in grams*
0	29.5
1	43.3
2	91.7

3	—
4	148.0
5	189.0
6	243.8
7	266.0
8	—
9	390.5
10	439.0
11	515.8
12	—
13	579.5
14	—
15	636.5
16	—
17	702.7
18	721.0
19	—
20	—
21	863.5

After the fifth month the young were released in two groups, the purpose being to determine to what extent these tame birds would adapt themselves to an independent way of life. In the initial stages this experiment was not very fortunate, since the young birds were visibly disturbed after having been released; some returned after only a few hours had elapsed and attempted to enter the fowl-run where they had originally been kept. By the second day the entire group had become re-united and showed no inclination whatever to leave the station grounds. At the end of the first week we found two of them in the garden in an advanced stage of debility, while the rest were also noticeably underfed and exhausted. We then placed quantities of food in various parts of the station grounds where they were known to congregate. This measure appeared to help and only one more bird was subsequently found in such an utterly exhausted state; the remainder of the brood recuperated rapidly as the result of the additional nourishment and visited the feeding-places more often. This state of affairs lasted about four months; towards the end of this period, however, they began to adapt themselves to their independence. They visited the feeding-places less frequently and sought the company of the wild guinea-fowls—these occur in large flocks in the Reserve during winter and spring—to an ever-increasing extent.

Since then, six of these birds were recaptured unexpectedly after 18 months, one mile from the place of ringing. From this fact it might be concluded that (a) the survival rate of these half-tame birds is, contrary to expectations, fairly high, and (b) that they are apparently reluctant to move far away from their home range. It may be safely assumed, however, that in the case of artificially hatched birds reared under conditions akin to those mentioned above, i.e. under as unrestricted conditions as possible, the movements would embrace a much larger area and would in fact coincide with those of the wild guinea-fowls.

On the basis of our experience, it might be said that the best method of rearing wild guinea-fowls is to allow a domestic hen to incubate the eggs and, after the first day, to permit foster-mother and young complete freedom of movement. This method would have the effect of increasing the mortality rate, but on the other hand the survivors would be spared the sudden and apparently critical transition period. They would become gradually accustomed to an uninhibited way of life and would desert their foster-mother after her attention was no longer necessary.

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The Giant Girdled Lizard or Sungazer

(*Cordylus giganteus* A. Smith)

V. FitzSimons

Transvaal Museum

THIS large, heavily armoured lizard is a member of the genus *Cordylus* or Girdled Lizards, whose name is derived from the fact that the scales are always arranged in regular transverse rows or girdles round the body.

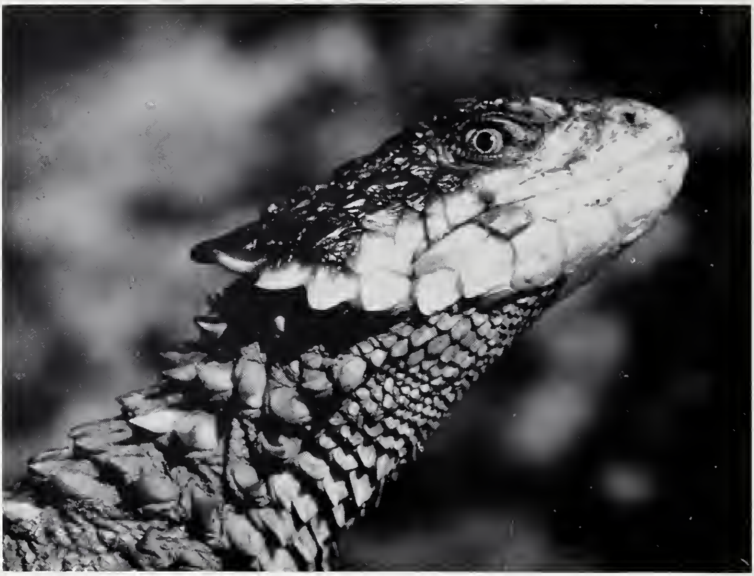
The species was first described and figured in 1844 by Andrew Smith (the father of South African Zoology) in his "Illustrated Zoology of Southern Africa—Reptiles, plates XXXV and XXXVI". The specimens on which he based his description are recorded as being from "the Interior districts of Southern Africa", and in all probability came from the eastern Orange Free State, through which he is known to have travelled on his way north into what is now the Transvaal. Smith also states "and (it) is not infrequently seen on the pinnacles of the Quathlamba Mountains, which separate the country of the south-east coast from that of the Interior"; this statement, however, is unacceptable, as we now know that this is not a montane species and, in all probability, what was actually seen was the closely related Leathery or Crag Lizards (Genus *Pseudocordylus*).

Shortly after Andrew Smith's description was published, the same lizard was described by Gray (1845, Catalogue of the Lizards in the British Museum of Natural History, pp. 48 and 270) under the name of *Zonurus derbianus*, in honour of Lord Derby, a supporter of the Museum. Although this scientific name has had to be synonymized, the common name given to it of Lord Derby's Girdled Lizard remained in use for many years.

Subsequent to its original finding and description by Andrew Smith, it was practically forgotten by zoologists, until in 1913 Dr. Robert Broom obtained an adult female from F. W. FitzSimons (the then Director of the Port Elizabeth Museum) and took it with him on a visit to England. During the voyage the specimen in question gave birth to two young. This happy event so intrigued Dr. Broom that he took the small family along with him to a meeting of the Zoological Society of London, held on 6th May, 1913.

Great interest and excitement was shown by the members present in the specimens, which were later lodged in the London Zoo where they lived for many years.

As its name *giganteus* implies, it is by far the largest member of the genus *Cordylus*, which is represented by close on 30 different forms distributed practically throughout the country. It grows to a total length of about 15 inches and is heavily armoured with large, keeled, mucronate scales and sharp, semi-erect spines. The scales on the back are all underlain by osteodermal (bony) plates, which form thus an extra protection against predators. On the other hand, the belly is covered with scales which are unsupported by these underlaying bony plates and is thus much more vulnerable. Of this vulnerability this lizard is apparently well aware, as it invariably makes every effort to protect this weak point by strenuously resisting any attempt to turn it over on its back.

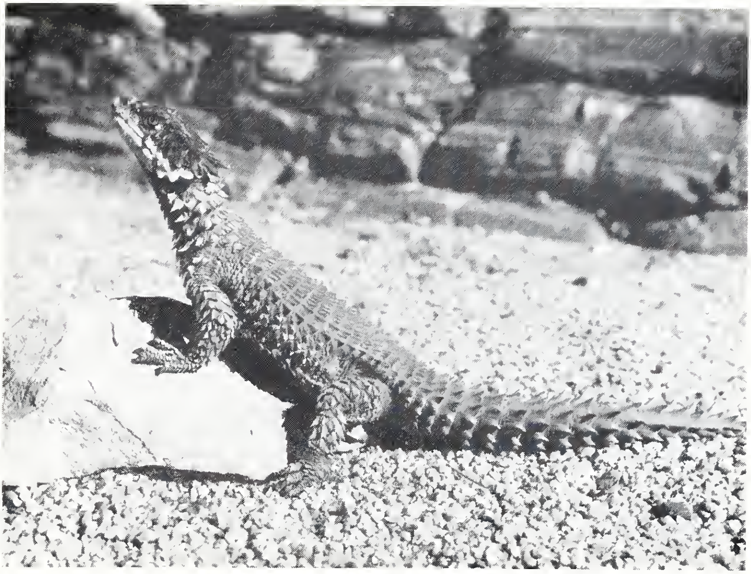


1. *Cordylus giganteus.* A close view of the head to show details of the heavily-armoured scaling.

Photo: C. K. Brain.

Details of the scaling are as follows: The head, which is large, flattened and subtriangular in shape, is covered with strongly rugose shields, of which those behind are much enlarged, strongly spinose and project as a fringe over the neck (see Ill. 1). The stout body is covered with large scales arranged in regular transverse rows; those on the back being subquadrangular in shape, strongly keeled and spinose, while those over the belly often tend to be subtriangular in shape and are for the most part smooth; the legs are also covered above with large, overlapping, keeled, spinose scales, but with much smaller, smooth scales below. The tail, which is thick and heavy, is particularly well armoured with regular whorls of large strongly keeled scales above, well developed, outwardly-directed spines on the sides and more or less smooth, elongate scales below. In adult males there are 10 to 12 conspicuous femoral pores on the lower surface of each hind-limb, and usually two or three rows of scales immediately in front are much swollen and glandular; similar patches of such swollen scales are often also noticeable under the upper arm and elbow. In very young specimens the scales are soft and smooth, but as they develop the osteodermal plates harden, while the scaling becomes progressively more horny, roughened and spinose as in the adult.

Unlike most other members of the genus, which are mainly rock-living, these lizards are essentially ground-living and more or less confined to the open High Veld of the eastern and central Orange Free State, and the adjoining areas of the Cape Province in the south, Basutoland in the east and Transvaal in the north. They live in holes in the ground and usually take over abandoned burrows of gerbilles, meercats, ground-squirrels, etc., which

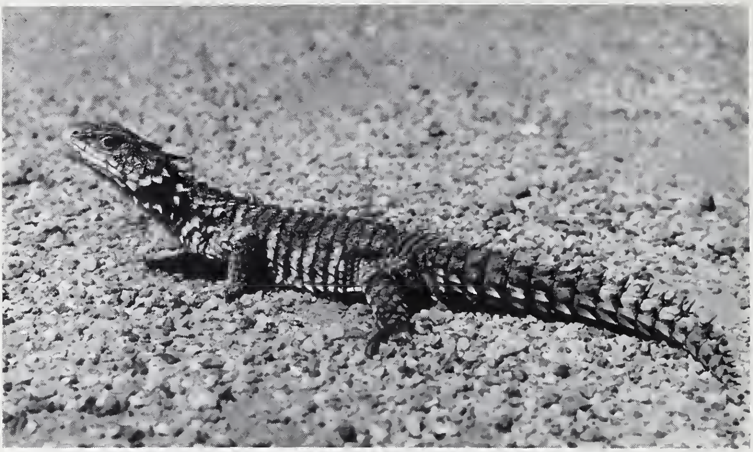


2. *Cordylus giganteus.* In characteristic sun-gazing pose. Photo: C. K. Brain.

may be anything up to six feet in length and end in an enlarged chamber in which the occupant(s) can easily turn round. In some parts of their range they are quite numerous and may be seen, particularly in the late afternoon, squatting immobile on small promontories, such as mounds of earth, termite hills, stones, etc., and facing directly into the sun (see Ill. 2). In this position they will often remain for long spells on end, retiring only to their burrows after the sun has set. This curious and characteristic habit has earned for them the singularly appropriate name of "sungazers". For their size and heavy build they are extremely alert and scamper about after their prey with head well raised off the ground (see Ill. 3). They are mainly insectivorous, but will take almost any small prey that they can overcome. In captivity they soon become very tame and, as they are also easy to feed (taking raw meat with relish), are much prized, particularly by overseas zoos, vivaria, etc. In view of this popularity it is fortunate that rigid protection and control has been imposed in the Transvaal, otherwise there would have been a real danger of this unique reptile becoming extinct.

As in other members of the genus, they are viviparous producing usually only two young at a time; these are born in late summer or autumn and are from 5 to 6 inches in length at birth.

In adults the colouring is unspectacular, being a practically uniform horn yellow to dark-brown above and straw yellow below, with or without dark greyish-brown to black markings over the neck and belly and cloudings of dark-brown on the tail. Young specimens differ very markedly from adults and, as a result, are often mistaken for a completely different type of lizard. The upper surface is yellow in front, passing to reddish behind and is distinctly marked with cross-bars or bands of liver-brown to black over the



3. *Cordylus giganteus.* In normal position when at rest or moving about.
Photo: C. K. Brain.

back; the tail is also banded alternately with black and yellow, but with the pale bands bearing numerous orange to brick red spots: the underparts are a uniform creamy yellow.

These lizards are most commonly known by their Afrikaans name of "Ou Volk", the origin and derivation of which appears to be obscure.

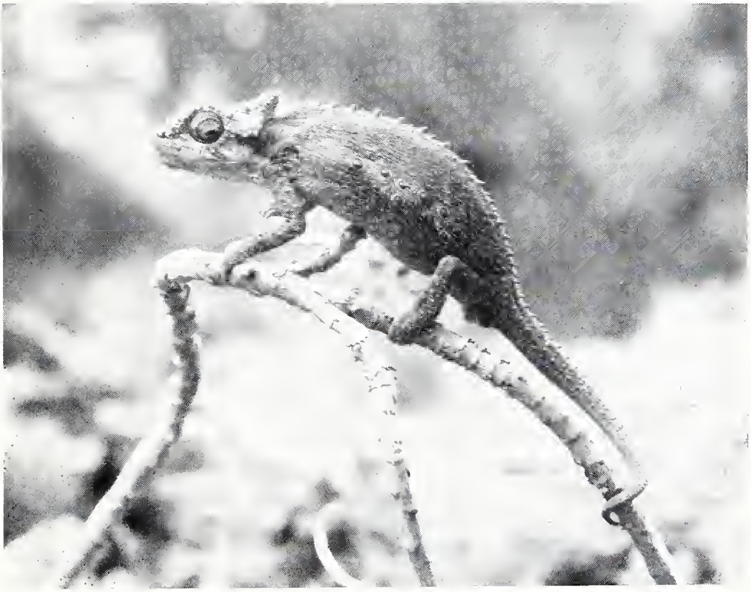
Dwarf or Bearded Chameleons

(Genus: *Microsaura*)

V. FitzSimons

(*Transvaal Museum*)

This group of small chameleons is confined to Southern Africa and was at one time included in the widespread (most of the African continent and Madagascar) genus *Chamaeleo*, but is now placed in a separate genus, *Microsaura*. Members of the group are characterized as follows: by the presence of a series of scaly, compressed, skin lobes or flaps (sometimes subtriangular in shape or reduced to conical protuberances) which form a "beard" extending from the chin to the base of the throat; ventral crest, rostral appendages and occipital flaps on back of head absent; usually two rows of enlarged disc-like, flattened tubercles along either side of the body; all members are viviparous, i.e. give birth to live young, and are of small size, ranging from 5 to 7 inches in total length, with the tail usually a little shorter or longer than the head and body.



The Karoo Dwarf or Bearded Chameleon [(*Microsaura ventralis karroica* (Methuen & Hewitt)] from Cradock district, C.P.

Photo: C. K. Brain

The genus is represented by about seven species and three sub-species, which are distributed from Little Namaqualand, eastwards across the southern half of the Cape Province, and thence northwards through Natal and Zululand into southern Moçambique and the north-eastern Transvaal (Woodbush district). They are found in widely different environments, from the dry, scrub-covered areas of Little Namaqualand and the southern Karoo to the high rainfall regions along the south and eastern coasts and inland along the Drakensburg escarpment. For reasons not yet clear, it would appear that the heavily bearded forms are confined to the drier parts of the country, while those with the beard reduced to conical tubercles are confined to the higher rainfall areas.

All produce fully developed live young, usually from 8 to 10 in number. These are born during midsummer and are produced one at a time over a period of an hour or two and, as each emerges, it is secured by the parent to a separate twig to which it adheres by its sticky transparent envelope or sac. Within minutes of deposition, the young inmate slits the enclosing sac and emerges as a fully developed and equipped miniature replica of the adult.

They are wholly insectivorous, but usually show a preference for small grasshoppers and other flying insects which are caught on the sticky-tipped tongue, as is characteristic of all chameleons.

Chameleons in general need plenty of moisture for their well-being and thus most species are found living in regions of high rainfall. However, some forms, such as those Dwarf or Bearded Chameleons of the *Microsaura ventralis* group, are confined to areas of low rainfall (i.e. southern Karoo, Little and Great Namaqualand), and in their case the necessary moisture is apparently provided by the relatively high atmospheric humidity and heavy dewfall so characteristic of such areas.

The particular form illustrated in the accompanying plate is the Karoo Dwarf or Bearded Chameleon (*Microsaura ventralis karroica*) from the Cradock district in the south-eastern Karoo.

(Editor's note: This short article has kindly been written by Dr. FitzSimons at the editor's request. Although the Karoo Dwarf or Bearded Chameleon does not occur in the Transvaal, its name will be added to the Transvaal's list of protected animals, because it has been illegally imported in large numbers from the Cradock District. All kinds of chameleons are protected in the Cape Province.)

The Angling Society as a Factor in Sport Fishing

P. le Roux

ACCORDING to the latest available figure roughly 70,000 angling licences are sold annually in Transvaal. It is estimated that, with the addition of children and unlicensed anglers, approximately 80,000 people participate actively in the sport of angling.

As in other sporting activities, anglers felt the need for closer social contact with one another, and this resulted in the formation of angling societies; this in turn led to the establishment of provincial and national bodies largely concerned with the aspects of competition and organization.

Seeing that the State has a direct interest in the source of these sporting activities, the fish and aquatic life, it follows that there has to be close contact between the two approaches. The authorities view the sport as a healthy recreational pastime which should be encouraged but at the same time controlled to ensure the perpetuation of the natural resource. Simultaneously timeous provision must be made for the needs of the ever-growing numbers of anglers. To this end there are not only strict legal provisions in the form of ordinances and regulations for the exploitation of fish, but provision has also been made for a special body to control exploitation and extend angling facilities.

On the other hand, the angling society sees the sport not only as recreation, but also as a real competition for certain much desired rewards, either of social or material value.

As a result of their organized action, angling societies sometimes create the impression that they are representative of *all anglers* in the province. Closer scrutiny reveals that this is not the case. In 1963 a survey was made of the membership of those Transvaal clubs that could be reached through the existing channels. It proved that even an optimistic estimate of the total membership could not exceed 20,000 anglers.

Only about one-quarter of the clubs had a membership of more than 100, and more than 40% had fewer than 50 members on their registers. The average number of members was about 90 per club, and the total number of clubs was estimated at 200.

It is clear that the authorities cannot interpret the interests of the angling societies as being those of the whole angling fraternity. Provision has to be made for anglers who do not belong to societies, and in this connection angling societies can strengthen the hands of the authorities considerably.

The angling society usually consists of enthusiasts who are well acquainted with the waters in their vicinity and also with the requirements of riparian owners; hence the society can be an excellent link between the angling public and the angling facilities. Societies can increase facilities, for instance, by obtaining and ensuring access to angling waters and can put such facilities at the disposal of the general public, at a fee if need be, without harming the society's interests at all. The authorities actively encourage such action by the provision of stocking fish and other services free of charge under certain conditions.

In exchange for the free stocking of club waters and active assistance with their management, the following requirements have to be met:—

1. The society must be a well established body with a permanent mem-

bership of more than 20. As proof hereof, it is necessary that the society's constitution should be available in printed form, and a sworn statement as to the membership must be produced.

2. Angling rights must be held on at least five acres of impounded waters or two miles of river frontage. It is expected that such rights must be assigned to the club by means of a proper contract for a minimum period of five years.
3. Such angling waters must be made available to the general public by means of a system of short-term membership (usually daily) at a fee not exceeding 50 cents per day. This is regarded as a reasonable return to a society for its trouble in making such facilities available.
4. An annual report must be submitted on activities and conditions in the waters of the society.

All the foregoing only aims at preventing opportunistic groups from obtaining fish free of charge and should entail no hardship to a proper angling society. The society almost functions as a representative of the State in that the functions of authority, i.e. protection and the provision of fish, are extended to the remotest parts of the province. Naturally a relatively small provincial organization cannot function everywhere equally well without disproportionate expansion, and hence the societies' aid is enlisted. When the professional knowledge of officials has been supplemented by the records and local experience of societies, spectacular improvements of angling have often resulted; this in turn leads to enhanced prestige of and support for the society.

Fisheries management is of necessity a long-term project, and hence any person or body concerned therewith would be well advised to collect and maintain comprehensive records of data.

The human memory is often remarkably untrustworthy for exact facts, but at the same time may be very convincing. In fisheries management precise measures cannot be formulated to cover all waters, and hence every water has to be treated on its merits. When considering any action in this connection, background and historical facts can often be of greater value than an intensive survey done at any specific time. As living populations in a variable environment are concerned, management and control would be greatly facilitated if the factual background is as comprehensive as possible.

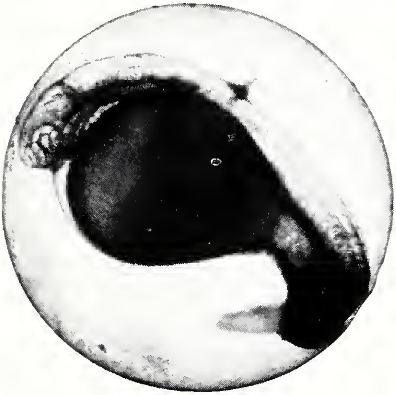
The angling society can also fulfil an important function in the field of control, again because a relatively small area is concerned and members are intimately acquainted with the waters. Existing legislation has to cover the whole of the province, and it would be completely impracticable to make allowances for variations between individual waters with their own unique characteristics. There is, however, nothing to prevent a society from exercising additional control measures on its own water when such are necessary, provided that minimum legislative requirements are complied with, or special permission for such measures has been obtained.

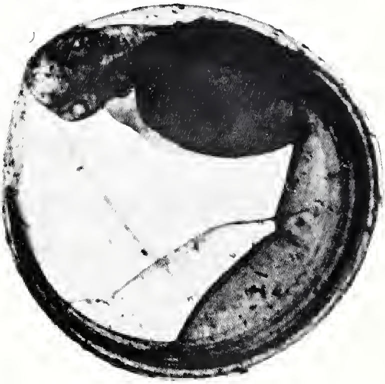
Societies legally enjoy the rights of ownership of waters over which they exercise angling rights, and trespassers can be dealt with according to the laws applicable to such ownership. It is clear, therefore, that a well-organized society can be a powerful factor in exercising proper control measures.

A final, most important function of angling societies is that of education—education of the rising generation to honour the principles of one of the oldest sporting activities; education in realizing the skill of this sport and putting it into practice; education in realizing that angling is primarily a healthy pastime and to a lesser degree an art or acquired skill and only in the final instance a competitive activity. One seldom hears of anglers who fish with barbless hooks or of streams where anglers may fish to their heart's content provided that all fish are returned to the water, yet such cases are actually known. With increasing human populations and the growing need of outdoor recreation, it is clear that the time will come when there will not be enough fish for all by present-day standards. This is not yet true of South Africa and Transvaal, and with good co-operation between enthusiastic angling societies and a conscientious authority it will not be the case for a long time to come.

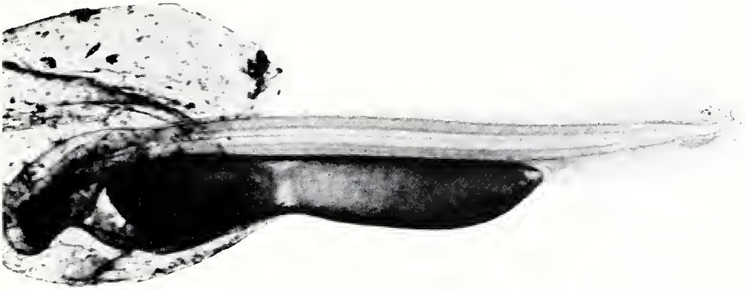
Birth of a Yellow Fish

(Barbus holubi)

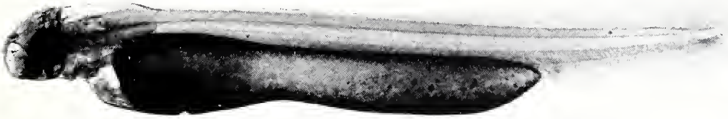




1. After a few days incubation in a gravel bed, the embryo nearly fills the egg.
2. A few hours later the embryo has developed further and now wriggles and strains head and tail against the egg membrane, which shows signs of weakening.



3. Too fast for the camera to follow, the membrane suddenly ruptures and the tail becomes free. After a short rest, further wriggling will free the body from the membrane.



4. Free at last! The delicate little fish is now ready to begin its struggle for life as an individual. For the next few days it will not feed but live off the contents of the yolk-sac, the dark mass to be seen in the abdominal region.

The Magnitude of Freshwater Angling in Transvaal

P. le Roux

EVERY now and then one hears that a certain number of angling licences was sold in a specified period. According to personal experience, such a figure is interpreted as being large or small and the matter is soon forgotten. In reality the sale of angling licences is an indication of the number of participants—active participants—in an age-old sporting pastime. It is a pastime which is becoming increasingly important in the modern world of high tensions, providing almost perfect relaxation. It is a duty of the State to provide for the needs of recreational angling, and hence attempts are continually being made to assess these needs. By using the licence sales and a little additional information, it is possible to estimate the magnitude of angling activities.

Since 1951/52 records have been kept of the total sales of licences, and the table below shows how the number of anglers has increased over the past years.

Years	*Total licence sales*
1951/52	30,038
1952/53	34,308
1953/54	38,470
1954/55	40,825
1955/56	45,605
1956/57	49,748
1957/58	56,029
1958/59	61,761
1959/60	62,653
1960/61	65,232
1961/62	64,440
1962/63	62,384
1963/64	68,486

In 1963/64 the number of licences sold constituted about 4.5% of the white population of the province, and it is to be expected that this proportion will continue to increase. In the United States of America it has been estimated that one person in every four takes part in recreational fishing.

The total licence sales in Transvaal do not indicate the total number of anglers by any means. Young people under 16 years of age do not need licences for fishing and neither do landowners fishing in waters situated on or abutting on their land. It can be confidently estimated that at least 80,000 people do some kind of fishing in any one year in the province.

The distribution of anglers follows the general population dispersion, so that the urban areas contribute most of the licensed anglers. It follows that these areas should have a high priority when the provision or improvement of angling facilities is considered.

In order to obtain a better understanding of the needs of these recreational anglers, a survey was undertaken in 1956/57 among licensed anglers to arrive at an estimate of their expenditure of both time and money, as well as their angling success. Although the results obtained must now be regarded as rather conservative estimates, they can still be used to give a general idea of the total angling activity.

It was found that on the average an angler spends about 35 days fishing in a year which costs him approximately R125. For this expenditure he takes home almost 70 fish weighing just under two pounds each. Of the total expenditure more than half was spent on transport and less than a quarter on angling equipment and camping gear. The rest was for refreshments, accommodation and incidental expenses. Licence fees formed an insignificant part of the total angling expense.

From the figures of this survey, we can calculate the magnitude of angling by the 68,000 anglers who took out licences in 1963/64 as follows:—

Man-days spent fishing	2,353,000
Total angling expenditure	R8,487,000
Total number of fish caught	4,733,000
Total weight of fish caught	4,680 tons

Although it was difficult to obtain accurate figures on actual catches, it was ascertained that the composition of the total catch (in 1956/57) was as follows:—

	By number	*By weight*
Carp (*Cyprinus carpio*)	15.2%	27.6%
Kurper (*Tilapia* spp.)	50.3%	29.6%
Yellow fish (*Barbus* spp.)	12.8%	14.4%
Barbel (*Clarias gariepinus*)	9.7%	19.5%
Mud-fish (*Labeo* spp.)	6.4%	5.2%
Others	5.6%	3.7%
TOTAL	100.0%	100.0%

That this trend continues has been borne out by returns of angling competitions submitted by clubs since 1962/63.

Although the past few years have not been very kind to anglers because of low rainfall and continually shrinking water supplies, angling opportunities continue to be adequate. The construction of further large impoundments (the mainstay of angling in Transvaal), as well as the more active interest taken by anglers themselves in procuring and developing waters should contribute to even better angling in future.

PUBLICATIONS

The following is supplementary to the list that appeared on pages 88 and 89 of *Fauna and Flora* Bulletin No. 14, 1963:—

35. Groenewald, A. A. (1955). A Revision of the Yellowfish of the Transvaal. Proc. of the Third Inter-Provincial Inland Fisheries Technical Conference, p. 17.
36. Le Roux, P. J. (1955). Physical and Biological Changes following Fertilization of Water. *Ibidem*, p. 40.
37. Le Roux, P. J. (1955). The Food of Tilapia in Dams. Ibid., p. 43.
38. Le Roux, P. J. (1955). The Effect of Ducks on Aquatic Weeds and Snails. Ibid. p.55.
39. Le Roux, P. J. (1955). Preliminary Report on Trout in Elands River. Ibid. p. 69.
40. Le Roux, P. J. (1955). The Feeding Habits of the Platanna (*Xenopus laevis*) in Ponds. Ibid. p. 106.
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42. Grafton, R. N. (1965). Food of the Black-backed Jackal: A preliminary Report Zoologica Africana, Ibid. p. 41.
43. Van Zyl, J. H. M. (1965). The Vegetation of the S.A. Lombard Nature Reserve and its Utilization by certain Antelope. Ibid. p. 35.
44. Van Rensburg, Rex. D. J. (1965). Preliminary Report on the " Humane Coyote-getter" for the Control of the Black-backed Jackal *Thos mesomelas* in the Transvaal. Ibid. p. 193.
45. Hirst, S. M., Kettlitz, W. K. & Visagie, G. P. (1965). The Use of Ro 5-2807 (Roche) as Tranquillizer in Wild Ungulates. Ibid. p. 231.

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GEOLOGIESE KAART VAN BARBERSPAN EN OMGEWING
GEOLOGICAL MAP OF THE BARBERSPAN REGION